

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8200.1A CHG 1

9/2/97

SUBJ: UNITED STATES STANDARD FLIGHT INSPECTION MANUAL

- 1. PURPOSE.** This change transmits revisions to the United States Standard Flight Inspection Manual (USSFIM), FAA Order 8200.1A, Department of the Army Technical Manual TM 95-225, Department of the Navy Manual NAVAIR 16-1-520, and Department of the Air Force Manual AFMAN 11-225, dated May 22, 1996.
- 2. DISTRIBUTION.** This change is distributed to selected offices on special mailing list ZVN-820. Distribution within the Department of Defense is handled by the National Imagery & Mapping Agency. For the U.S. Air Force, this revision is included in the AF STDPUBs CD-ROM and is available on the internet (<http://afpubs.hq.af.mil/>).
- 3. CANCELLATIONS.** This change cancels GENOT 8200.64 dated September 23, 1996, and GENOT 8200.65 dated April 14, 1997.
- 4. EFFECTIVE DATE.** This change is effective October 15, 1997.
- 5. EXPLANATION OF CHANGES.**
 - a. Section 104.**
 - (1) Paragraph 104.5. Clarified definition of special flight inspections.
 - (2) Paragraph 104.51. Clarified definition of After Accident Response inspections.
 - (3) Paragraph 104.52. Establishes that engineering/installation personnel shall be responsible for determining which monitored references are to be checked based on the facility reconfiguration.
 - b. Section 105.** Clarifies criteria for overdue facility; Table 105-1 reformatted for clarity and MLS interval added.
 - c. Section 106, Paragraph 106.44.** Restated for clarity.
 - d. Section 107, Paragraph 107.3b(2).** NFDC office symbol updated.

Distribution: ZVN-820

Initiated By: AVN-230

Section 201.

(1) Checklist. Paragraph references corrected to reflect true applicable paragraph number. Footnote 1: Alignment orbit requirement changed. Footnote 4: Clarified to indicate checklist requirements apply to both VOR and TACAN facilities supporting a SIAP or receiver checkpoint.

(2) Paragraph 201.32031. Intersection Radials/DME Fixes clarified.

(3) Paragraph 201.32032. Figure 201-2 added for clarity.

(2) Paragraph 201.3204e. Changed minimum requirement for evaluating polarization from when within 10 miles of the station to within 5 nm of the station.

(3) Paragraph 201.32052. Average course alignment requirements clarified.

(4) Paragraph 201.44. References to 9960 kHz changed to 9960 Hz.

(5) Paragraph 201.51d. Reference to 9960 kHz changed to 9960 Hz.

(6) Paragraph 201.51f(2). VOR tolerance deviations for radial course structure clarified.

(7) Paragraph 201.52. Reference checkpoint paragraph for TACAN tolerances deleted. TACAN tolerance deviations for radial course structure clarified.

f. Section 202, Paragraph 202.31 Checklist. Polarization requirements deleted.

g. Section 207.

(1) Paragraph 207.31 Checklist. Corrected paragraph references for standby transmitter and power.

(2) Paragraph 207.3203. Deleted requirement for facility radiating at reduced RF power reference level as determined by Airway Facilities.

(3) Paragraph 207.3204b. Clarifies requirement for periodic inspection of SIAP.

(4) Paragraph 207.3207. Clarifies requirements for inspection of standby equipment at facilities where dual transmitters are installed.

h. Section 208.

(1) Paragraph 208.3204. Clarifies inspection procedures for coverage.

(2) Paragraph 208.3205. Establishes criteria for long-distance check.

(3) Paragraph 208.4b. Corrects IHF transceiver to UHF transceiver.

(4) Paragraph 208.5. Clarifies ADF needle oscillation maximum as a bearing error tolerance.

(5) Paragraph 208.6. Adjustments paragraph deleted; paragraph 208.7 renumbered.

i. Section 211.

- (1) Paragraph 211.3201d. Light gun signals added.
- (2) Paragraph 211.32011. Light gun communications added to terminal communications.
- (3) Paragraph 211.5. Clarifies maximum recommended coverage tolerances.

j. Section 212.

- (1) Paragraph 212.31 Checklist. Periodic requirement added to bearing accuracy. Alignment orbit added.
- (2) Paragraph 212.3202. Paragraphs 212.32023c and d moved to 212.3202b and c.
- (3) Paragraph 212.32025. Clarifies requirements for periodic inspections.
- (4) Paragraph 212.32026. Clarifies requirements for orbit procedure for commissioning inspections.
- (5) Paragraph 212.3203. Clarifies communications and coverage.
- (5) Paragraph 212.3207. Establishes requirements for emergency DF approach check.

k. Section 213.

- (1) Paragraph 213.11. GPS System Description added.
- (2) Paragraph 213.32. GPS non-precision approach procedures defined.
- (3) Paragraph 213.321b. FAS positioning requirements established.
- (3) Paragraph 213.43. WPDE clarified for position determination.
- (4) Paragraph 213.44. Other parameters and expected values added.

l. Section 214.

- (1) Paragraph 214.2. Changes requirement for delivering data necessary for conducting the flight inspection to the FICO instead of the FIO or IFIO.
- (2) Paragraph 214.3. Verification of Obstacle Clearance clarified.
- (2) Paragraph 214.5. Distance accuracy, bearing accuracy, and system fix displacement deleted from tolerances.

i. Section 211.

- (1) Paragraph 211.3201d. Light gun signals added.
- (2) Paragraph 211.32011. Light gun communications added to terminal communications.
- (3) Paragraph 211.5. Clarifies maximum recommended coverage tolerances.

j. Section 212.

- (1) Paragraph 212.31 Checklist. Periodic requirement added to bearing accuracy. Alignment orbit added.
- (2) Paragraph 212.3202. Paragraphs 212.32023c and d moved to 212.3202b and c.
- (3) Paragraph 212.32025. Clarifies requirements for periodic inspections.
- (4) Paragraph 212.32026. Clarifies requirements for orbit procedure for commissioning inspections.
- (5) Paragraph 212.3203. Clarifies communications and coverage.
- (5) Paragraph 212.3207. Establishes requirements for emergency DF approach check.

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- (1) Paragraph 213.11. GPS System Description added.
- (2) Paragraph 213.32. GPS non-precision approach procedures defined.
- (3) Paragraph 213.321b. FAS positioning requirements established.
- (3) Paragraph 213.43. WPDE clarified for position determination.
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- (1) Paragraph 214.2. Changes requirement for delivering data necessary for conducting the flight inspection to the FICO instead of the FIO or IFIO.
- (2) Paragraph 214.3. Verification of Obstacle Clearance clarified.
- (2) Paragraph 214.5. Distance accuracy, bearing accuracy, and system fix displacement deleted from tolerances.

(20) Paragraph 215.3211. Approved procedure for ATCRBS Modes and Codes clarified.

(21) Paragraph 215.3212b. Clarifies power level and approved procedures to be used for ATCRBS power optimization checks.

(22) Paragraph 215.3213. Clarifies approved procedures and refers to Checklist for flight inspection aircraft settings to be used during an ATCRBS GTC/STC evaluation.

n. Section 216.

(1) Paragraph 216.31 Checklist. Deleted periodic requirement to check each runway annually.

(2) Paragraph 216.311. Last sentence of footnote 1 corrected to refer to runs 1 and 4. Footnote 5: periodic inspection requirement statement deleted.

o. Section 217.

(1) Paragraph 217.3101a. MRN-7 deleted.

(2) Paragraph 217.3101b. MRN-7 deleted. Footnote 4 deleted and checklist adjusted.

(3) Paragraph 217.3101g. Remark (5) deleted. Transverse structure (structure below path) requirements clarified.

(4) Paragraph 217.3204. Approved procedure for power ratio check clarified.

(5) Paragraph 217.3207a(1)(b). Typographical and formatting errors corrected.

(6) Paragraph 217.3207b. Clarifies zones to be inspected for structure.

(7) Paragraph 217.3210a. Clearance orbit radius changed to 5 to 10 miles from the antenna at the LCA.

(8) Paragraph 217.3212. Evaluating coverage for fixes and transitions clarified. Figure 217-2. Stations clarified.

(9) Paragraph 217.3214. LDA corrected to read "LCA".

(10) Paragraph 217.3303. Removed reference to precision microammeter.

(11) Paragraph 217.3304d(1). Footnote 2 in checklist clarified.

(12) Page 217-26. Airborne phasing procedure reference paragraph corrected.

(13) Paragraph 217.3309. Instructions for applying actual angle correction factor to the level run angles in the Tilt check added.

(14) Paragraph 217.3311c. Paragraph deleted.

(15) Paragraph 217.3313. Last sentence of paragraph deleted.

(16) Paragraph 217.43a. Reference to deviations in Sector 1 deleted and redefined in subparagraph c which was added.

(17) Paragraph 217.45a. CAT III exception deleted from (4).

(18) Paragraph 217.5. Power ratio tolerance/limit clarified and requirement for periodic deleted from checklist. Note 1 clarified and Note 2 added to Front Course Structure. Front and Back Course label added. Structure Below Path tolerance/limit clarified. Requirement for periodic check for RF Power deleted from checklist.

(19) Paragraph 217.6. Deleted statement about not needing to optimize a facility during routine periodic checks.

p. Section 218. Headings of Figures 218-1 and 218-2 changed to reflect "Runways With Approach Light Systems".

q. Section 220.

(1) Paragraph 220.31. Requirement for periodic check of OCI Orbit deleted from checklist.

(2) Paragraph 220.3203c. Clarifies vertical coverage inspection requirement.

(3) Paragraph 220.3204c. Paragraph added for MLS approaches which support azimuth only minima.

(4) Paragraph 220.3205. Guidance for evaluating MMLS monitor limits added.

(5) Paragraph 220.51. Grammatically clarified.

(6) Paragraph 220.52c(4). Guidance added for Zone 4 and 5 PFE, PFN, and CMN.

(7) Paragraph 220.54. Added for military facilities.

(8) Figures 220-3 - 220-6. 4 nm clarified in graphics.

r. Section 301. Abbreviations for FAS, FAWP, IAWP, IWP, MAHWP, and MATWP added and defined.

s. Section 302. MLS PFE/PFN Angular Tolerance formula added (Paragraph 302.10).

t. Section 305. Errors in VHF/UHF NAVAID Frequency Channeling and Pairing chart corrected.

6. DISPOSAL OF TRANSMITTAL. After filing the revised pages, the change transmittal should be retained.

(15) Paragraph 217.3313. Last sentence of paragraph deleted.

(16) Paragraph 217.43a. Reference to deviations in Sector 1 deleted and redefined in subparagraph c which was added.

(17) Paragraph 217.45a. CAT III exception deleted from (4).

(18) Paragraph 217.5. Power ratio tolerance/limit clarified and requirement for periodic deleted from checklist. Note 1 clarified and Note 2 added to Front Course Structure. Front and Back Course label added. Structure Below Path tolerance/limit clarified. Requirement for periodic check for RF Power deleted from checklist.

(19) Paragraph 217.6. Deleted statement about not needing to optimize a facility during routine periodic checks.

p. Section 218. Headings of Figures 218-1 and 218-2 changed to reflect "Runways With Approach Light Systems".

q. Section 220.

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(3) Paragraph 220.3204c. Paragraph added for MLS approaches which support azimuth only minima.

(4) Paragraph 220.3205. Guidance for evaluating MMLS monitor limits added.

(5) Paragraph 220.51. Grammatically clarified.

(6) Paragraph 220.52c(4). Guidance added for Zone 4 and 5 PFE, PFN, and CMN.

(7) Paragraph 220.54. Added for military facilities.

(8) Figures 220-3 - 220-6. 4 nm clarified in graphics.

r. Section 301. Abbreviations for FAS, FAWP, IAWP, IWP, MAHWP, and MATWP added and defined.

s. Section 302. MLS PFE/PFN Angular Tolerance formula added (Paragraph 302.10).

t. Section 305. Errors in VHF/UHF NAVAID Frequency Channeling and Pairing chart corrected.

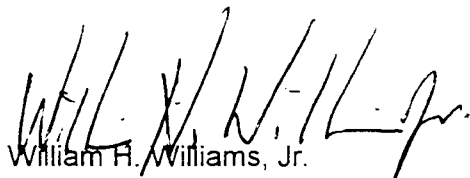
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SECTION 103. SPECIAL REQUIREMENTS

103.1 INTRODUCTION. This section describes the concept for the special requirements of the aircraft, flight inspection crewmembers, and air-borne and ground support equipment used for flight Inspection.

103.2 AIRCRAFT. Flight inspection organizations (Office of Aviation System Standards (AVN), regions, and the U.S. Military) shall identify specific requirements based on their operational needs. The general characteristics of an aircraft used to perform flight inspection are as follows:

- a. **Reliable multi-engine** type aircraft capable of safe flight with one engine inoperative and equipped for night and instrument flight.
- b. **Sufficient capacity** for a flight inspection crew, observers, ground maintenance and/or installation personnel, and required electronic equipment with spares.
- c. **Sufficient range and endurance** for a normal mission without reservicing.
- d. **Aerodynamically stable** throughout the speed range.
- e. **Low noise and vibration level.**
- f. **Adequate and stable electrical system** capable of operating required electronic and recording equipment and other aircraft equipment.

g. **Wide speed and altitude range** to allow the conduct of flight inspections under normal conditions as encountered by the users.

h. **Appropriate for modifications** of flight inspection of new and improved navigation services.

103.3 FLIGHT INSPECTION CREWMEMBERS. Flight inspection organizations certifying air navigation services shall develop a program to formally certify flight inspection personnel. The objectives of this program are to:

- a. **Grant authority to the flight inspection crewmember** who carries out the administration's responsibility of ensuring the satisfactory operation of air navigation services and/or instrument flight procedures.
- b. **Provide a uniform method** for examining employee competence.
- c. **Issue credentials** which authenticate certification authority for the crewmember.

103.4 AIRBORNE AND GROUND SUPPORT EQUIPMENT. Aircraft and ground support flight inspection equipment shall be calibrated to a standard traceable to the National Bureau of Standards (See TI 4160.1).

SECTION 104. TYPES AND PRIORITIES OF FLIGHT INSPECTIONS

104.1 INTRODUCTION. Official flight inspections are of five basic types: site evaluation, commissioning, periodic, special, and surveillance.

104.2 SITE EVALUATION: A flight inspection to determine the suitability of a proposed site for the permanent installation of a facility. It may include checks normally made during a commissioning inspection and any additional tests which may be required.

104.3 COMMISSIONING: A comprehensive flight inspection designed to obtain complete information as to system performance and to establish that the system will support its operational requirements.

104.4 PERIODIC: A regularly scheduled flight inspection to determine that the system meets standards and supports the operational requirements.

104.5 SPECIAL FLIGHT INSPECTIONS are inspections performed outside the normal periodic interval. They may be used to define/evaluate performance characteristics of systems, subsystems, or individual facilities. Facilities maintenance personnel shall be responsible for coordinating with flight inspection which checks are to be accomplished, based on their requirements and type of maintenance performed on the equipment.

104.51 After Accident. This inspection is performed at the request of the accident coordinator/investigator to verify that system performance is satisfactory and continues to support instrument flight procedure(s).

a. Response. This inspection has a priority of 1a and should be accomplished as soon as possible.

b. Preflight Requirements. The flight inspector shall obtain the following information:

(1) Equipment configuration at the time of the accident, i.e., the receiver(s), transmitter(s), or radar channel(s) in operation.

(2) Instrument flight procedure(s) used.

(3) Any additional information that may aid in the inspection analysis.

c. Inspection Procedure(s).

(1) Coordinate with maintenance to configure the system as indicated in paragraph b(1).

(2) Complete periodic checklist requirements. Only the equipment and instrument flight procedures used by the accident aircraft need to be checked. Do not make any facility adjustments during the after accident inspection. Any adjustments shall require a separate special inspection.

(3) If a system or procedure has no periodic inspection requirements, evaluate performance in the area in which the accident occurred.

(4) Complete any additional items requested by maintenance, air traffic control personnel, the accident coordinator, or the commander at a military facility.

(5) Where an accident involves contact with the terrain or a manmade obstruction, confirm the procedural controlling obstruction by map study or flight evaluation.

d. Dissemination of After Accident Information. All flight inspection findings or other pertinent accident investigation information shall be restricted to the cognizant accident coordinator/investigator, maintenance, and air traffic personnel. Results of the flight inspection shall be given to the FAA Inspector-in-Charge (IIC) as soon as possible. A flight inspection report shall be filed in accordance with current directives.

104.52 Reconfiguration. A special flight inspection requested by maintenance when modifications or the relocation of a facility affect the radiation pattern of the facility. All commissioning checks should be performed following a facility reconfiguration, except those that are not required as determined jointly by flight inspection and facilities maintenance personnel. Commissioning tolerances shall be applied.

104.53 Inspections of Shipboard TACANs are considered complete at the termination of the inspection. Any subsequent inspection shall be a new "special" inspection.

104.6 SURVEILLANCE. A flight inspection performed on a commissioned system or procedure that determines if the parameter(s) inspected meets standards. An out-of-tolerance condition found on a surveillance inspection shall require a special flight inspection and a flight inspection report.

104.61 Surveillance of Aeronautical Services.

During the course of routine flight check operations, flight inspection personnel shall be alert for items which are unusual, substandard, or possibly hazardous.

a. Inspections. Inspections shall include, but not be limited to, the following:

(1) Condition of runways, taxiways, and ramp areas.

(2) Runway, taxiway paint markings, and position signs missing or deteriorated to the extent that visual guidance is obscured or missing.

(3) Construction activity at airports which is a hazardous condition or might affect NAVAID performance.

(4) New obstructions in the instrument approach area which might become the controlling obstruction or constitute a hazardous condition.

(5) Brush or tree growth obstructing the view of approach lights.

(6) Obscured or broken runway or obstruction lights.

(7) Other hazardous situations, e.g., bird hazards.

(8) Air traffic services, e.g., clearances, flight plans, communications, etc.

(9) Other services, e.g., weather bureau services or other airport support services.

b. Reports. See FAA Order 8240.36, Instructions for Flight Inspection Reporting, latest edition.

104.7 PRIORITIES OF FLIGHT INSPECTIONS.

The priority for flight inspections shall be:

Priority	Type of Service
1a	Accident Investigation, any facility which has exceeded its inspection interval, inspection of facilities in support of military contingencies, or other nationally directed military deployments.
1b	Restoration of a commissioned facility after an unscheduled outage, restoration of CAT II/III ILS approach minimums, or inspection of NAVAIDs in support of military operational readiness and JCS directed exercises.
1c	Flight inspection of reported malfunctions.
1d	Restoration of a commissioned facility following a scheduled shutdown or inspections supporting DOD NAVAID evaluations (USAF TRACALS).
2a	Site evaluation.
2b	Commissioning inspection of a new facility or new instrument flight procedures.
3a	Periodic inspections.
3b	Restoration of standby equipment (except CAT II/III ILS, see priority 1b).
3c	Restoration of VFR training facilities following a scheduled or unscheduled outage.

SECTION 105. FREQUENCY OF PERIODIC FLIGHT INSPECTIONS**TABLE OF CONTENTS**

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SECTION 105. FREQUENCY OF PERIODIC FLIGHT INSPECTIONS

105.1 INTRODUCTION. This section prescribes the minimum frequency of periodic flight inspections. More frequent inspections may be made when deemed necessary or as requested by the owner or organization responsible for the operation of the facility.

105.11 General

a. Intervals. Table 105-1 specifies the intervals between scheduled periodic flight inspections. Due dates for periodic inspections are based on this schedule. Military, foreign, and MOA systems, facilities, and procedures may have unique requirements and non-standard inspection intervals. All records and reports will reflect the actual date(s) of the inspection and will specifically denote the date of completion. For inspections completed within the due date window or extension, the next inspection will be predicated upon the scheduled facility due date.

(1) Due date window for facilities with a 90-day periodicity is from 15 days before to 15 days after the due date.

(2) Due date window for all other facilities, systems, and procedures is from 60 days before to 60 days after the due date.

b. Scheduling.

(1) NAVAIDs such as VORTAC, VOR/DME, ILS, MLS, etc., shall be flight inspected as a service with the same due date and inspection interval for all component facilities.

(2) The inspection priority shall be raised to 1a when the system, facility, or procedure has exceeded the end of the due date window.

(3) Periodic inspections are considered complete when all scheduled checks are accomplished except as noted below for Standby Equipment.

c. Progressive Inspections. The requirements for periodic inspections are specified in a checklist in each section of this order. Partial or progressive inspections may be conducted, provided all of the individual periodic checklist items are satisfied within the due date window.

105.2 Extension of Services Overdue Periodic Inspection. When the inspection of a commissioned facility is not completed within the due date window, the facility may continue to operate for seven (7) additional calendar days. The Flight Inspection Central Operations Office and regional facility maintenance engineering shall agree that no conditions exist that could adversely affect the safety of flight if the facility is left in service. The flight inspection priority of a facility in the extension is the same as an overdue facility.

105.3 NAVAIDS Temporarily Out-of-Service.

a. Use the priority listed in paragraph 104.7 of this order when a restoration inspection is required. The next periodic inspection shall be predicated on the completion date of an inspection which satisfies all periodic checklist requirements.

b. When a portion of a NAVAID is restored to service, the periodic due dates shall be established in accordance with paragraphs 105.11 and 105.4.

c. Standby Equipment. When flight inspection of standby equipment is required but cannot be accomplished, the periodic inspection shall be considered complete if the standby equipment is:

(1) Out-of-service (awaiting parts, etc.) or;

(2) Removed from service (due to an uncorrectable discrepancy, etc.) The standby equipment shall be restored to service by the successful completion of a flight inspection which satisfies all periodic requirements (including monitors, where applicable).

105.4 Periodic Flight Inspection Intervals.

The schedule for periodic flight inspections shall be in accordance with Table 105-1.

a. Establishing the Interval.

(1) Commissioning. Newly commissioned precision facilities shall initially be inspected at a 90, 180, and 270-day interval (periodic with monitors), and then maintain the schedule established in Table 105-1. This requirement applies to upgrading of a service, such as the addition of a glide slope to a localizer only facility.

(2) Specials other than reconfigurations. Facilities may be restored to the existing periodicity without further checks once the special is complete and deemed satisfactory by Airway Facilities engineering or maintenance personnel. Update the periodic due date if all system periodic requirements for the next scheduled periodic inspection are completed during any special inspection.

(3) Reconfiguration of Precision Approach Services.

Reconfigured precision approach services shall initially be checked at 90-days. A full periodic with monitor reference check on all facilities within the system shall be scheduled as part of this special, and the periodic with monitors shall be updated on the Daily Flight Log (DFL). The next periodic due date will be at the 270-day interval.

105.41 Monitor (or Reference) Intervals.

Monitors (or reference) check intervals shall be twice the established (Table 105-1) facility periodic interval.

Table 105-1 Basic Schedule for Periodic Flight Inspection
(all intervals are in days)

Precision:

Facility	Interval
ILS	270
MLS	270 (2)
MMLS	180
PAR	270 (2)

SIAP (Precision)	Conduct during monitor (reference) checks
------------------	---

Non-Precision:

Facility	Interval
ASR (Military Approaches)	540
DF	540
FMS	(2)
GPS	540
LDA/SDF/LOC only/ SDF with GS	540 (3)
LORAN C	540
NDB (UHF, LF/MF)	540
VOR, VORTAC, TAC	540 (1)
VOT	540
DME, VGSI, Marker Beacons, Communications, and Approach Lighting Systems	Inspect these facilities at the same interval as the system or procedure they support.

SIAP (Non-Precision)	Conduct at same interval as facility
----------------------	---

- Notes:
- (1) 540 days for facilities which support a SIAP or receiver checkpoint. An alignment orbit is required every 1,080 days for all facilities.
 - (2) SIAP check required every 540 days. See Paragraph 214.3e.
 - (3) Monitors required every other inspection. See Paragraph 105.41.

Table 105-1 Basic Schedule for Periodic Flight Inspection
(all intervals are in days)

Precision:

Facility	Interval
ILS	270
MLS	270 (2)
MMLS	180
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SIAP (Precision)	Conduct during monitor (reference) checks
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Facility	Interval
ASR (Military Approaches)	540
DF	540
FMS	(2)
GPS	540
LDA/SDF/LOC only/ SDF with GS	540 (3)
LORAN C	540
NDB (UHF, LF/MF)	540
VOR, VORTAC, TAC	540 (1)
VOT	540
DME, VGSI, Marker Beacons, Communications, and Approach Lighting Systems	Inspect these facilities at the same interval as the system or procedure they support.

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- Notes:
- (1) 540 days for facilities which support a SIAP or receiver checkpoint. An alignment orbit is required every 1,080 days for all facilities.
 - (2) SIAP check required every 540 days. See Paragraph 214.3e.
 - (3) Monitors required every other inspection. See Paragraph 105.41.

SECTION 106. GENERAL FLIGHT INSPECTION PROCEDURES

106.1 INTRODUCTION. Sequence of events encountered by the flight inspector in the performance of the flight inspection mission is generally as follows:

- a. Request for flight inspection
- b. Preflight preparation
- c. Actual flight inspection
- d. Analysis and evaluation
- e. Post flight review and reporting

106.2 REQUEST FOR FLIGHT INSPECTION. Site, commissioning, and some special flight inspections shall be requested by authorized personnel. Requests are not required for periodic flight inspections.

106.21 Status of Equipment. A request for flight inspection should not be initiated until all required facility equipment is installed, properly adjusted, calibrated, and operating normally.

106.22 Notification. The flight inspector or central scheduling and dispatch facility shall notify the appropriate airway facility maintenance personnel of the estimated time of arrival (ETA) of the flight inspection aircraft. As much advance notification as possible shall be provided for a site evaluation, commissioning inspection, periodic with monitors, or special inspections requiring maintenance.

A periodic inspection without monitors does not require pre-coordination with maintenance personnel. This inspection should be conducted on the transmitter in operation. If an out-of-tolerance condition is found, notify maintenance of the discrepancy(ies) found and inspect the standby equipment. NOTAMs should be issued if discrepancies are not corrected.

106.3 PREFLIGHT INSPECTION PREPARATION. A thorough and complete understanding between facilities maintenance personnel and the flight inspection crew is essential for a successful flight inspection. The flight inspector and the person-in-charge of the facility are jointly responsible for the required coordination before, during, and after the flight

inspection. The flight inspector will brief the facilities maintenance personnel of intended actions prior to commissioning flight inspections and for special circumstances.

106.31 Facilities Maintenance Personnel. Efficient and expeditious flight inspections require preflight preparations and actions of facilities maintenance personnel. These preparations include the following actions:

a. Provide adequate two-way radio communications equipment and power source at facility sites. Two-way communication should be provided by flight inspection when a theodolite or RTT is required.

b. Ensure that all facility equipment is calibrated in accordance with technical orders.

c. Ensure personnel will be available to make corrections and adjustments.

d. Provide transportation to move flight inspection equipment and personnel.

e. Provide accurate facility data for new or relocated facilities.

106.32 Flight Personnel. The following actions shall be accomplished prior to the flight inspection:

a. Ensure that all flight inspection equipment is calibrated and operational.

b. Brief facilities maintenance personnel.

c. Conduct crew briefing.

d. Obtain maps, charts, equipment, data sheets, etc.

e. Review the status, limitations, and characteristics of the facility. Ensure that all publications and records agree with the results of the latest flight inspection, and all applicable restrictions are accurate.

f. **Brief the air traffic control (ATC) personnel** about the areas and altitudes to be flown during the flight inspection maneuvers and of possible transmitter changes.

106.4 FLIGHT INSPECTION. Perform the flight inspection in accordance with the procedures in Chapter 200 of this manual.

106.41 Operator Proficiency. During flight inspections, qualified personnel will be assigned so operator deviations will not be confused with equipment performance.

106.42 Standby Equipment. It is necessary to know which system or transmitter is operating so the performance of each can be determined.

a. **When one unit** of a dual equipped facility is found out-of-tolerance, it shall be identified and removed from service. The unit can be identified as transmitter number 1 or 2, channel A or B, serial number, etc.

b. **Some inspections** may only require the checking of one equipment. The details for each type of facility are included in the appropriate facility checklists.

106.43 Standby Power

a. The flight inspector shall check the facility on standby power during a commissioning flight inspection if standby power is installed. If a standby power system is installed after the commissioning flight inspection, the flight inspector shall check the facility on standby power during the next regularly scheduled periodic inspection. The flight inspector shall make comparative measurements to ensure that facility performance is not derogated on the standby power system and that all tolerance parameters for the specific inspection are met. Standby power checks are not required on facilities powered by batteries that are constantly charged by another power source.

b. It is not necessary to recheck a facility when the standby power source is changed.

106.44 On-Station Philosophy. Flight inspectors shall assist in resolving facility deficiencies and restoring the facility to service prior to departure.

106.45 Adjustments. Requests for adjustment shall be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance shall be rechecked by flight inspection. Flight inspection certification shall be based on facility performance after all adjustments are completed.

106.5 ANALYSIS AND EVALUATION

a. **Flight inspection data** shall be analyzed and evaluated by flight inspection using the tolerances specified in this manual. Recordings made during the flight inspections are the permanent records of facility performance.

b. **On request, pertinent flight recordings** will be made available to facilities maintenance personnel for engineering analysis. The recordings will be preserved and promptly returned to the flight inspection unit upon completion of the analysis.

106.6 POST FLIGHT INSPECTION ACTIONS. Upon completion of the flight inspection, the flight inspection crew shall perform the following actions:

a. **Brief facilities maintenance personnel**

b. **Determine facility status**

c. **Prescribe the issuance and/or cancellation of NOTAMs.**

d. **Prepare flight inspection reports**

e. **Ensure flight information is published**

106.61 Brief facilities maintenance personnel concerning results of the flight inspection. Flight inspection shall report all facility outages to appropriate personnel.

106.62 Facility Status. Flight inspection shall assign a status for the facility (see Section 107). Flight Inspection shall also notify the appropriate personnel of the facility status.

106.63 NOTAMs. The flight inspector shall prescribe the issuance and/or cancellation of NOTAMs based on the flight inspection (see Section 107.)

SECTION 107. FACILITY STATUS CLASSIFICATION AND NOTICES TO AIRMEN (NOTAM)

107.1 INTRODUCTION. Air navigational and traffic control facilities are expected to be usable within specific limits of distances and altitudes (service volume). Facility status classification and NOTAMs will indicate restriction(s) to the expected use of these facilities. The facility status classification indicates the general performance of the facility as determined from each flight inspection. This classification is directed only to the maintenance and/or operating agency. The NOTAM advises the user of any restriction to facility usage.

107.2 FACILITY STATUS CLASSIFICATION. Based on the performance of the facility, flight inspection shall assign one of the following status classifications:

a. Unrestricted. The status of a facility which meets established tolerances.

b. Restricted. The status of a facility which does not meet established tolerances (areas shall be clearly defined as unusable in a NOTAM).

c. Unusable. The status of a facility which is unsafe or unreliable for navigation (a NOTAM shall be issued for the facility defining it as unusable).

107.3 NOTAMs.

a. Facility NOTAMs. The flight inspector shall immediately initiate NOTAM action whenever a facility restriction is found or revised. FAA Order 7930.2, Notices to Airmen (NOTAM) Handbook (latest edition), and the instructions in this order shall be used to issue NOTAMs. An FDC FI NOTAM shall be issued if a restriction affects instrument flight procedures, approach minimums, or category (CAT) II or III authorizations. To initiate NOTAM action, advise the appropriate Flight Service Station (FSS) or Military Base Operations (for Army facilities, notify the ATC Facility Chief). Recommend a NOTAM be issued defining the restrictions found. The flight inspector shall verify that the appropriate NOTAMs were issued correctly within 24 hours.

The flight inspector shall verify that the correct NOTAM is published in the appropriate agency publications.

b. Instrument Flight Procedures. The flight inspector shall coordinate NAVAID NOTAMs with the procedures specialist, as restrictions to NAVAIDs may affect published instrument flight procedures. The procedures specialist shall:

(1) Determine what published instrument flight procedures are affected.

(2) Initiate appropriate NOTAMs that amend or suspend those procedures by calling the National Flight Data Center (NFDC), Flight Procedures/Airspace Section, ATA-100, for civil and Army facilities, (for other military facilities, notify the appropriate Military Base Operations).

NOTE: During NFDC non-duty hours (1700-0800 eastern), the FDC NOTAM is to be forwarded to the NOTAM office (ATA-100).

(3) Review the NAVAID restrictions to determine what effect they will have on the instrument flight procedures. The central scheduling and dispatch facility will ensure that the required NOTAMs are immediately transmitted to NFDC. If the procedures specialist is not available, the flight inspector shall verify that any required NOTAMs are issued.

c. Facilities not requiring NOTAMs. Do not issue a NOTAM to reflect restrictions found during the flight check of radar or direction finding facilities; however, review the instrument flight procedures to ensure that those requiring ground radar are amended or suspended. Coordinate this action with the procedures specialists.

d. Expanded Service Volume (ESV) Facilities. When a facility no longer supports an ESV, the facility is not restricted, but a NOTAM must be issued for the instrument flight procedures predicated on that ESV. Coordinate and publish the newly established ESV and instrument flight procedures.

e. Out-of-Tolerance Standby Equipment. Where one of two transmitters of a facility is restricted due to out-of-tolerance parameters and the other is satisfactory, the satisfactory transmitter may be operated without a NOTAM. However, NOTAM data describing the restriction shall be provided to facilities maintenance personnel. In the event the restricted transmitter is used, the operating agency shall issue the NOTAM.

107.31 NOTAMs on Military Facilities (including ships).

a. The military installation commander has the final authority and responsibility for NOTAM issuance and for facility operations of all military facilities which are not part of the National Airspace System (NAS). The commander may elect to use "For Military Use Only" facilities found unsatisfactory for continued NAS usage.

b. The flight inspector will recommend NOTAMs to the military commander's representative (see paragraph 107.34) when facilities under the commander's jurisdiction require NOTAM action.

c. NOTAMs shall not be issued on shipboard facilities.

107.32 Preparation of NOTAMs

a. NOTAMs shall include facility name, type, component, and the unusable area/altitude. The absence of a specific altitude or distance will denote all altitudes and distances. It is important to include specific information to avoid confusion. The reason for the restriction, e.g., lack of signal, frequency interference, course structure, alignment, unlocks, etc., serves no useful purpose and shall not be included in the text of the NOTAM.

b. Restrictions to TACAN azimuth are not included in agency publications, but are referred to the military for dissemination as they consider necessary. A copy of each NOTAM issued or recommended for TACAN azimuth restrictions shall be retained in the facility file for reference during subsequent flight inspections. The NOTAM preparation for the TACAN azimuth component of a VORTAC is identical to the VOR.

107.33 Facility Restrictions. Apply the following rules for restricted facility use:

a. Describe the radials or bearings that are unusable.

b. Describe the altitude and mileages that are unusable.

107.34 NOTAM Examples. The following are examples of conditions and prescribed NOTAMs:

a. Condition 1. All components of a VORTAC are unusable in a specific sector due to out-of-tolerance VOR and TACAN course structure and unusable DME. **NOTAM, Chicago VORTAC:** VOR, DME, and TACAN azimuth unusable, 025-075° beyond 25 nm below 3,500 feet.

b. Condition 2. A VOR does not provide adequate signal to 40 miles at the required altitudes in various areas. **NOTAM Altoona VOR:** VOR unusable, 080-100° beyond 18 nm below 3,500 feet; 101-200° beyond 30 nm below 3,500 feet; 201-300° beyond 30 nm below 4,500 feet; 301-350° beyond 15 nm; 351-010° beyond 30 nm below 4,000 feet.

c. Condition 3. VOR is unusable in various areas below one altitude. Also, the DME is unusable in one sector. **NOTAM, Yardley VORTAC:** VOR unusable below 1,700 feet in the following areas: 250-265° beyond 17 nm; 266-280° beyond 10 nm; and 281-290° beyond 17 nm. DME unusable 225-275° in the following areas: Beyond 15 nm below 2,400 feet and beyond 30 nm below 5,000 feet.

d. Condition 4. A Nondirectional radio beacon is not usable in the Southeast quadrant. **NOTAM Bradford NDB:** unusable 090-180° beyond 15 nm.

e. Condition 5. Glide slope tolerances are exceeded at a specific point on the glidepath. **NOTAM, Ashville Regional, NC:** Rwy 16 ILS glide slope unusable below 2,310 feet MSL.

f. Condition 6. An ILS localizer exceeds tolerances at 1/2 mile from the runway threshold. **NOTAM, Hartsville Muni, SC,** Rwy 16 ILS unusable from 1/2 nm inbound.

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SECTION 201. RHO THETA SYSTEMS

201.1 INTRODUCTION. Rho Theta Systems include Very High Frequency Omni-directional Range (VOR) and TACAN.

201.2 PREFLIGHT REQUIREMENTS.

201.21 Facilities Maintenance Personnel shall participate in the facility certification flight inspections and whenever adjustments are required (paragraph 106.31).

201.22 Flight Personnel. In addition to the preparation outlined in paragraph 106.32, the flight inspection personnel shall prepare charts, plot the position of the facility, and depict the orbit and radial checkpoints that will be used during the evaluations.

201.3 FLIGHT INSPECTION PROCEDURES.

a. An approved automated flight inspection system (AFIS) is the preferred method for conducting a facility flight inspection using procedures contained in appropriate agency directives. When using the AFIS to evaluate actual alignment of orbits or radials, the two following updating methods may be used.

(1) Global positioning system (GPS) hybrid or equivalent (5 nm and beyond)

(2) Distance measuring equipment (DME) (10 nm and beyond)

b. When AFIS is not available, the evaluation procedures specified in this section shall be used.

c. When using a theodolite to evaluate facility performance, it shall be positioned and operated by a certified operator. The theodolite azimuth bearings shall be referenced to magnetic bearings "from" the facility (paragraph 201.44).

201.31 Checklist. The checklist prescribes the items to be inspected on each specific type of inspection.

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(2) Distance measuring equipment (DME) (10 nm and beyond)

b. When AFIS is not available, the evaluation procedures specified in this section shall be used.

c. When using a theodolite to evaluate facility performance, it shall be positioned and operated by a certified operator. The theodolite azimuth bearings shall be referenced to magnetic bearings "from" the facility (paragraph 201.44).

201.31 Checklist. The checklist prescribes the items to be inspected on each specific type of inspection.

201.32 Detailed Procedures. Prior to performing the checks listed below, sensing and rotation must be verified (see paragraph 201.44)

201.3201 Reference Radial Check.

a. A reference radial shall be established during commissioning. It is recommended that a reference radial be established using an approach radial for the facility under evaluation. The radial should lie over a well defined ground reference checkpoint, on a theodolite bearing, or AFIS segment. When course roughness and scalloping occur during an alignment evaluation, the graphic average of the deviations shall be used.

b. A reference checkpoint for DME facilities shall be established as described in paragraph 201.32041.

201.3202 Monitor Reference Evaluation.

a. The monitor reference evaluation determines the minimum amount of azimuth course shift required to activate the ground facility monitor alarm system.

b. Monitor reference may be established either in the air or on the ground. Once established, the check shall become the reference for all subsequent checks. The procedure for establishing a monitor reference is as follows:

(1) With the course in the normal operating condition.

(2) With the course shifted to the monitor reference point.

(3) With the course shifted to the monitor reference point in the opposite direction from step (2) above.

(4) With the course returned to the normal operating condition.

NOTE: Step (4). There is no requirement that the course return to the measurement in Step (1). Monitor shifts of more than 1° will be brought to the attention of appropriate engineering personnel to determine if environmental or equipment related.

In each of these conditions, the course alignment will be compared by reference to recorded data to determine the amount of shift to the alarm point and to verify that it has returned to a normal condition.

c. Facilities that have dual parallel monitors require a monitor evaluation on one transmitter only. Facilities that have two individual monitors require evaluations on each transmitter.

201.3203 En route Radials

a. All radials supporting instrument flight procedures shall be checked for signal quality and accuracy. Fly the en route radials throughout the length of the intended use or facility flight inspection coverage requirement, whichever is greater. On "L" and "H" class facilities, fly the coverage radials at a minimum altitude of 1,000 feet (2,000 feet in designated mountainous terrain) above the highest terrain or obstruction to a distance of 40 miles or 25 miles for "T" class facilities. The 40-mile or 25-mile distances are considered the standard flight inspection coverage distances. If en route radials have coverage requirements beyond the previously mentioned flight inspection coverage distances, the radials shall be inspected to the additional distances at the minimum altitudes, unless otherwise requested.

b. Changeover Points. The minimum en route altitude (MEA) for an airway change-over point shall be the altitude where usable signals exist from all supporting stations. There is no requirement to check coverage beyond the COP.

c. Evaluate azimuth alignment, course sensitivity or modulations, polarization, roughness and scalloping, bends, identification, voice features, sensing, and signal strength while flying the desired azimuth. Check for facility azimuth rotation while intercepting the radial.

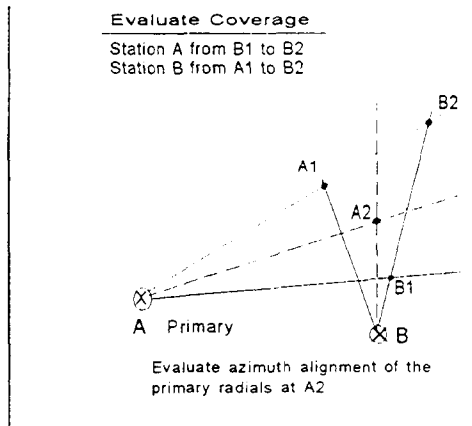
201.32031 Intersection Radials/DME Fixes

a. Intersections are used to identify azimuth positions in space. These intersections can be used for navigational fixes, reporting points, COP, RNAV waypoints, etc. It is necessary to establish a MRA or MOCA for each intersection. The MRA is the lowest altitude where reliable signals can be received.

b. The stations are evaluated on the furthest side from each facility for each fix to ensure that usable signals exist. Evaluations of intersection radials shall include course sensitivity or modulations, identification, roughness and scalloping, alignment, and signal strength.

c. DME Fixes shall be evaluated for coverage ± 4 nm or 4.5^0 (whichever is greater) at 5 nm greater than the fix distance.

Figure 201-1



The radials of the primary facility are evaluated at ± 4 miles or ± 4.5 degrees, whichever is greater. The crossing radial is evaluated at ± 3.6 degrees.

NOTE: The primary facility provides primary course guidance to the intersection. If either facility can be the primary, then evaluate both at ± 4 miles or ± 4.5 degrees. If the crossing facility is an NDB, the primary facility is evaluated $\pm 5^\circ$ from the NDB on-course bearing.

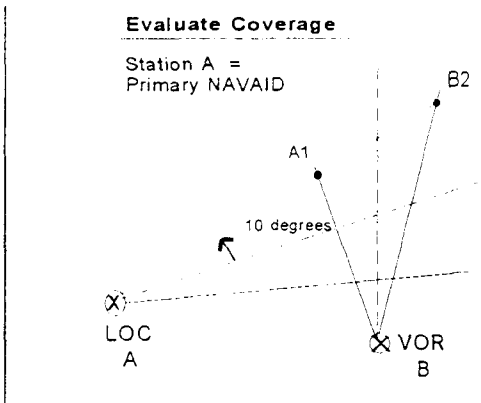
201.32032 Radials Identifying Fixes for Other Types of NAVAIDs.

a. These intersections may be reporting points, FAFs, etc. It is necessary to establish an MRA or MOCA for each intersection.

b. An evaluation is conducted while the aircraft is "on course" using the primary NAVAID for guidance. When using other types of NAVAIDs for primary course guidance, the radial is evaluated as a crossing radial (see paragraph .32031b). When the primary NAVAID is a localizer or localizer-type facility, crossing radial coverage will be evaluated on the extremity of localizer Sector 1 furthest from the VOR being evaluated (A1 to B2, Figure 201-2). When the primary NAVAID (Station A in Figure 201-2) is an NDB, the crossing VOR radial shall be evaluated at an NDB bearing 5° beyond the on-course bearing.

c. Evaluate azimuth alignment, course sensitivity or modulations, identification, roughness and scalloping, and signal strength.

Figure 201-2



201.3204 Terminal Radials (Approach, Missed Approach, Transition STARs, SIDs).

a. Evaluate all the radial segments that comprise the STAR, SID, or SIAP. Ensure the procedure is compatible with human factors (see paragraph 214.43) and the navigational guidance is satisfactory. On commissioning inspections, the radials shall be evaluated to include the holding patterns, procedure turns, approach and missed approach, or departure routings. During periodic inspections of SIAPs, evaluate the final approach segment only. Evaluate other terminal radials on a surveillance basis.

b. All evaluations shall be conducted at the procedural altitudes except the final approach segment. This segment is evaluated from the FAF (or final descent point) descending to 100 feet below the lowest MDA to the MAP. During site, commissioning, reconfiguration, and certain other special inspections, evaluate VOR radials 5 degrees on each side of the final approach radial. Evaluate the offset VOR radials at the same altitudes as the final approach radial segment.

c. TACAN Null Checks will be flown as follows:

(1) Approved Procedure

(a) On commissioning inspections, antenna change, and new procedures, the following null checks are required:

1 Approach radial

2 5 degrees either side of the approach radial

The radials will be flown in/out bound, on a level flight, from 3 miles outside the final approach fix (FAF) to 3 miles inside the FAF at the lowest minimum altitude for FAF:

(b) Nulls, defined as any repeatable out-of-tolerance crosspointer action or condition of unlock usually accompanied by rapid changes in the automatic gain control (AGC) and oscilloscope indications of a loss or distortion of the 15 and 135 cycle modulation components, are not permitted in this area. If a null is found, measure the vertical angle by flight in the area described above at an altitude 500 feet above or below the minimum FAF altitude and inform maintenance so that the problem can be corrected if possible. If the null cannot be corrected by antenna change or height adjustment, a new procedure will be developed which will avoid the affected area. Null checks are required on only one transponder.

d. Commissioning Inspections. On commissioning inspections, missed approach and standard instrument departure (SID) radials for facilities which are located within the airfield boundary shall be evaluated from overhead the station outbound to the limits depicted for the procedure. If no termination point is depicted, the radial shall be checked to where it joins the en route structure or the expected coverage limit of the facility category, i.e., 25 miles for a "T" class and 40 miles for "L" or "H" class facilities.

e. Evaluate the radials for signal quality and accuracy. The final approach course shall deliver the aircraft to the desired aiming point. Evaluate course sensitivity or modulations, polarization (when within 5 to 20 nm of the station), roughness and scalloping, bends, identification, and signal strength when flying the radials. Evaluate the 5-degree offset radials for course sensitivity or modulations, roughness and scalloping, spectrum analysis, identification, and signal strength.

201.32041 Distance Accuracy. Check the accuracy of the TACAN/DME distance information during inspection of the radials, orbits, approach procedures, and DME fixes. The exact mileage indication displayed on the distance indicators shall be noted on the recordings. Comparison of the scaled distance on the chart (converted to slant range) to the distance indicated by the TACAN/DME distance indicator at the various points may be made for accuracy determination.

a. It is not necessary to compute the slant range for distances measured at altitudes below a vertical angle of 5 degrees because the relative difference between slant and chart range is negligible (less than 1/2 to 1 percent).

b. For ease of computation, a 5-degree angle is equivalent to approximately 1,000 feet above the antenna at 2 miles and 5,000 feet above the antenna at 10 miles. Above a 5-degree angle, a DME slant range mileage shall be converted to chart distance.

201.32042 Erroneous Distance Information. If the ground facility is emitting false reply pulses, erroneous distance information may be present. This condition usually occurs within 25 miles of the antenna. Whenever actual false lock-ons are experienced, the offending facility shall be removed from service until this condition is remedied.

201.3205 Orbit Evaluations. Orbit evaluations are used to determine azimuth error distribution and signal quality. Orbit data are used as reference information. Ground checkpoints, theodolite, or AFIS may be used for azimuth references.

201.32051 Coverage Orbits.

a. This check is conducted primarily to obtain coverage data for site and commissioning inspections of "L" and "H" class facilities. The coverage requirements for the "T" class facilities do not require data beyond a distance of 25 miles. For "L" and "H" class facilities, one complete 40-mile orbit (one transmitter only) shall be flown on site and commissioning inspections.

(1) One thousand feet above the facility site elevation or intervening terrain (2,000 feet above the terrain in designated mountainous areas), whichever is higher.

(2) An altitude high enough to receive in-tolerance signals. If this altitude is higher than the altitudes in paragraph (1) above, a facility restriction and NOTAM are required for these areas. Areas of unsatisfactory coverage outside the SSV shall not constitute a facility restriction.

b. Expanded service volumes (ESVs) are required when they are procedurally used outside the standard service volumes.

c. During the orbit, evaluate azimuth alignment, course sensitivity or modulations, sensing and rotation, roughness and scalloping, identification, and signal strength (a minimum of 1 evaluation every 20 degrees).

d. Out-of-tolerance conditions discovered during orbital inspections shall be confirmed by a radial inspection before restricting a facility or issuing a NOTAM. The radial inspection results normally have priority over orbital inspection data.

201.32052 Alignment Orbit

a. The alignment orbit is used to determine the accuracy and optimum error distribution of the azimuth. The evaluation is conducted for 360 degrees of azimuth. An orbit radius of five nautical miles (nm) and beyond may be used when using GPS hybrid or equivalent for updating and 10 nm and beyond when using distance measuring equipment updating. When using theodolite, the orbit radius shall be maximum visual range for the theodolite operator. The orbit may be flown clockwise (CW) or counterclockwise (CCW), but once established, it shall be flown in the same direction on each subsequent inspection. Compute a tapeline altitude to fly the orbit at a standard angle of 4 to 6 degrees from the site. The objective of the check is to help facilities maintenance personnel determine environmental problems close in to the facility. The ratio between distance and altitude becomes critical when looking for low angle reflections or shadowing. Altitudes may be modified when conditions prevent establishing the altitude at the recommended 4 to 6 degrees (air traffic requirements, engineering or maintenance support, and site conditions). Indicate deviations from the standard on the flight inspection report. Maintain a ground speed that provides approximately 4 to 6 samples per degree for the orbit distance flown.

b. If alignment cannot be determined orbitally, it may be measured by flying one radial in each quadrant. The radial alignment shall be determined from no less than a 5 nm segment flown within the distance and angular parameters noted above. A partial orbit, augmented with radial alignment, is preferred over alignment determined solely by radial means. The use of radial flight in lieu of orbital alignment shall be approved by Flight Inspection Technical Support.

c. One orbit may be flown on dual transmitter facilities during any inspection, except commissioning, by requesting transmitter changes. If sufficient transmitter changes cannot be accommodated (at least one in every 90°), fly an orbit on each transmitter.

d. During the orbit, evaluate azimuth alignment, course sensitivity or modulations, sensing and rotation, roughness and scalloping, identification, and signal strength (a minimum of 1 evaluation every 20 degrees). Out-of-tolerance conditions found during an orbital inspection shall be confirmed by a radial evaluation before restricting a facility or issuing a NOTAM. The radial evaluations normally have priority.

e. Course Alignment. If an average course alignment of more than one degree is found, contact facilities maintenance. Facilities maintenance will conduct an evaluation to determine if the change in the facility was caused by a maintenance problem or caused by an environmental change. When course improvement adjustments require confirming flight inspection, complete the checklist items for facility rotation (para 201.31).

201.3206 Ground Receiver Checkpoints

a. Ground receiver checkpoints will be established on the airport ramp or taxiways at points selected for easy access by aircraft, but where there will be no obstruction of other airport traffic. They normally will not be established at distances less than one-half mile from the facility, nor should they be established on non-paved areas.

b. During the commissioning inspection, align the aircraft toward the station with the aircraft receiving antenna over the selected point. Determine the correct facility radial and round off to the nearest whole degree. Position the aircraft receiving antenna alternately in three additional positions 90 degrees apart, and check for alignment stability. This radial will be published as the ground receiver checkpoint azimuth. Periodic flight inspections will be evaluated with the aircraft aligned toward the station and the receiving antenna over the checkpoint.

c. All azimuth bearings shall be stable and within prescribed azimuth tolerance. Evaluate azimuth alignment, course sensitivity or modulations, roughness and scalloping, identification, and signal strength. If a stable signal and alignment cannot be obtained at a location, select another site or establish an airborne receiver checkpoint.

201.42 Voice.

a. **The voice broadcast feature**, when installed, allows a user to receive radio communications, weather and altimeter information, air traffic and airport advisories, etc. on the VOR frequency. Voice amplitude modulates the VOR carrier frequency by 30 percent.

b. **Inspect the voice for clarity** to ensure there is no adverse effect on the azimuth course. Ensure that all published remote sites can respond on the VOR frequency when contacted. Maintain a periodic surveillance of the quality and coverage of the voice transmissions throughout the VOR coverage area.

c. **When the voice transmissions** are unsatisfactory, but the remainder of the VOR operation is satisfactory, NOTAM only the voice feature out-of-service. When the voice modulation adversely affects the VOR operations, the voice portion must be disabled and NOTAMed out-of-service or the VOR shall be NOTAMed out-of-service.

201.43 Sensing and Rotation.

a. **The sensing and the following rotation check** are required at the beginning of the flight inspection. The position of the aircraft on a radial from the station must be known. Rotate the course selector (OBS, CDI, etc.) to the azimuth of the radial being flown. When the crosspointer is centered, the "TO-FROM" indicator will properly indicate "FROM" if sensing is correct. Sensing should be checked before rotation, as incorrect sensing may in itself cause the station rotation to appear reversed.

b. **Rotation.** Upon completion of the sensing check, conduct a partial counterclockwise orbit. The radial bearings shall continually decrease.

201.44 Modulation Levels.

a. **Modulation Levels.** The three individual modulation levels associated with the VOR are: 30 Hz AM, the 30 Hz FM (or deviation ratio of the 9960 Hz subcarrier) and the 9960 Hz AM modulation of the VOR RF carrier.

(1) 30 Hz AM is optimized at 30 percent and is termed the "variable phase" on conventional VORs.

(2) 30 Hz FM (a deviation ratio of 16 is equivalent to 30 percent modulation value) is termed the "reference phase" on a conventional VOR. On Doppler VORs, it is termed the "variable phase."

(3) 9960 Hz AM is optimized at 30 percent. The 9960 Hz amplitude modulation of the VOR RF carrier may cause receiver flag warnings when out-of-tolerance.

Modulation values shall meet operational tolerances throughout the unrestricted service volume of a VOR. Determine the average modulation values or the graphical average of the recorded modulation values (when available) when fluctuations are encountered.

b. **Analysis.** Adjustments of modulation values may be made on any radial (within 10 to 25 miles of the facility).

201.45 Polarization.

a. **Polarization** causes azimuth course variations whenever the aircraft is banked around its longitudinal axis. It is caused by the radiation of a vertically polarized signal from the VOR antennas (horizontal polarization on TACAN) or other reflective surfaces around the site. The indications are similar to course roughness and scalloping, but normally can be separated by relating the course deviations to the aircraft banking. When roughness and scalloping cannot be separated from polarization, select another radial. The evaluations should be conducted on another nearby radial in the same azimuth quadrant.

b. **Evaluation.** Polarization should be evaluated any time a radial is checked and within 5 to 20 miles (inbound or outbound) from the facility. Only one radial required on TACAN. The preferred method of evaluating for polarization is to bank the aircraft 30 degrees around the longitudinal axis (starting on either side) returning to level flight momentarily, bank 30 degrees in the opposite direction and returning to straight and level flight. During the aircraft banking, the tracking and heading changes must be kept to a minimum. The course deviations that occur during the 30-degree rolls may indicate polarization.

If out-of-tolerance conditions are discovered using this method, a confirmation check using the methods prescribed in paragraph 201.45c is required. The indications of polarization may be influenced by course roughness and scalloping.

c. Confirmation Procedure. The polarization may be evaluated by the 30-degree bank, 360-degree turn method. This procedure is accomplished by flying over a prominent ground checkpoint (within 10 and 20 miles from the facility) executing a 30-degree bank and turn, and holding this attitude through 360 degrees, ending this maneuver as close to the same ground checkpoint as possible. While conducting this procedure, the recording should be marked at the beginning and end and at each 90-degree change in azimuth heading. If polarization is not present, the course will indicate a smooth departure from and return to the "on-course" position, deviating only by the amount that the aircraft is displaced from the original azimuth.

201.46 Spectrum Analysis.

a. The RF electromagnetic spectrum from 108 to 118 MHz is reserved for VOR and ILS localizer signals. Undesirable RF signals can be radiated in this frequency band that interfere with the VOR signals. Electromagnetic interference (EFI) signals can be produced by electrical manufacturing processes, power generating facilities, etc., which may be sporadic. Radio frequency interference (RFI) may be caused by other VORs, harmonics of other frequencies, FM stations, etc. which are usually continuous. The Regional Frequency Management and/or Spectrum Engineering Division are the primary offices responsible for predicting and evaluating frequency interference in the VOR frequency band.

b. The VOR spectrum shall be monitored for undesirable electromagnetic radiation when RF interference is suspected. When interfering radiation is observed, it is not justification for restricting the facility unless other flight inspection tolerances are exceeded. Undesirable signals shall be reported to Facilities Maintenance or the Regional Frequency Management and/or Spectrum Engineering Division. If facility restrictions and NOTAMs are established by frequency management studies or predictions, the origin of these restrictions shall be identified. These restrictions shall not be removed by flight inspection alone.

201.4601 Analysis of TACAN (Oscilloscope).

The oscilloscope should be used for analysis of TACAN signals. The following are suggested analytical procedures, and no facility restrictions are to be applied if adjustment cannot be made or if maintenance personnel are not available for adjustment. The composite video, when displayed on the oscilloscope, will yield considerable data about the TACAN facility. The oscilloscope may be used to measure the following composite video parameters:

- (1) 15 Hz modulation
- (2) 135 Hz modulation
- (3) Identification train
- (4) Reflections
- (5) MRG size
- (6) Auxiliary Reference Group (ARG) size
- (7) ARG count

201.4602 Modulation Percentage 135 and 15 Hz. Measure the modulation of each component measured from the composite video and calculate the modulation percentage (see Section 302).

a. Modulation measures are more easily and accurately made by the TACAN test set. The oscilloscope should be used only when the TACAN test set is not available for use.

b. Identification Train. To measure the ident spacing group, adjust the oscilloscope so that the main burst is on the left edge of the graticule and the first auxiliary burst is on the right edge. When the ident is on, the reference bursts and the ident groups become very evenly spaced, and a group should appear on each division line.

c. Reflections. Reflected signals may be detected by examining the composite video. Reflections, when present, may duplicate the normal pattern in an image pattern slightly displaced to the right. Reflections may be of sufficient amplitude to cause the pattern amplitude to oscillate or cause the modulation percentage to oscillate at a sine wave frequency dependent on velocity and position of the aircraft.

d. Main Reference Group Size. Size refers to the number of pulse pairs in a group. For "X" channel, there should be 12 pulse pairs in the main reference group spaced 30 usec apart with spacing of each pulse in a pair of 12 usec. For "Y" channel, there are 13 single pulses in the MRG spaced 30 usec apart. If the TACAN test set indicates a discrepancy in the group size, use of the oscilloscope will identify the trouble. Advising maintenance of the condition found will greatly ease their task of correcting the problem.

e. Auxiliary Reference Group Size. Size refers to the number of pulse pairs in an auxiliary reference group. For "X" channel, there should be six pulse pairs spaced 24 usec apart with spacing of each pulse in a pair of 12 usec. For "Y" channel, there are 13 single pulses in a group spaced 15 usec apart. If the TACAN test set indicates a discrepancy in the group size, use of the oscilloscope will identify the trouble.

Advising maintenance of the condition will ease their task of correcting the problem.

f. Auxiliary Reference Group Count. Count refers to the number of auxiliary reference groups between North reference bursts or groups. There are eight auxiliary reference groups between North reference bursts. If the TACAN test set shows the loss of auxiliary reference groups, use of the oscilloscope will quickly identify the exact problem. Advising maintenance of the condition will greatly ease their task of correcting the problem.

g. Operational Limits. Oscilloscope measurements should fall within the following limits:

Parameters	Limit	Remarks
15 Hz Modulation	12 to 30 percent	Antennae with modulation greater than 30 percent are in use.
135 Hz Modulation	12 to 30 percent	If no derogation of facility performance exists, these limits may be ignored but advise maintenance.
Identification pulse spacing	740 microseconds	Synchronized with burst.
Reflections	N/A	No derogation of facility performance.
MRG size	12 \pm 1 pulse pair	
ARG size	6 \pm 1 pulse pair	
ARG count	8 \pm 0 burst	

201.47 Course Structure

a. Roughness, scalloping, and bends are displayed on the recorder charts as deviations of the crosspointer (course deviation indicator) recording trace. Roughness will show a series of ragged irregular deviations; scalloping as a series of smooth rhythmic deviations; and the frequency of each is such that it is not flyable and must be "averaged out" to obtain a course.

b. To measure the amplitude of roughness and scalloping, or the combination, draw two lines on the recording which are tangential to and along each positive and negative peak of the course deviation. The number of degrees or microamperes between these lines will be the total magnitude of course deviations; one-half of this magnitude will be the plus and minus deviations.

c. The third line is drawn equidistant from these lines to obtain the average "on course" from which course alignment is

measured. Thus, the alignment error of the course may be computed from the course recordings at any point where an accurate checkpoint has been marked on the recording. Alignment error will be referred to in degrees to the nearest tenth. Misalignment in a clockwise direction is considered positive. Where the magnetic azimuth of the measured (ground) checkpoint is greater than the electronic radial, the error is positive.

d. A bend is similar to scalloping except its frequency is such that an aircraft can be maneuvered throughout a bend to maintain a centered crosspointer. Accordingly, a bend might be described as a brief misalignment of the course. Bends are sometimes difficult to discern, especially in those areas where good ground checkpoints or other means of aircraft positioning are not available. It is, therefore, important to the analysis of a bend to consider aircraft heading and radial alignment deviations.

A smooth deviation of the course over a distance of two miles would manifest itself as a bend for a flight inspection aircraft at a ground speed of 150 knots. An aircraft of greater speed would not detect such smooth deviations of the course as a bend unless it were over a greater distance. In the analysis of bends, further consideration should be given to the flight levels and speeds of potential users. Since speed, altitude, system response, and other factors are important in the analysis of course structure, the flight inspector should carefully evaluate the flyability factor before assigning a final facility classification.

201.48 Signal Strength. During all flight inspection evaluations, the received signal shall be equal to or greater than the specified tolerance.

201.5 TOLERANCES. Facilities that meet tolerances throughout the flight inspection SSV are classified as UNRESTRICTED. Facilities that do not meet tolerances in the flight inspection SSV are classified as RESTRICTED. Appropriate NOTAM action shall be taken to notify the user of the unusable areas (see Section 107). Facilities which do not meet tolerances beyond the flight inspection SSV shall not be restricted; however, procedural use shall be denied.

201.51 VOR Tolerances

a. Identification. Morse code and voice identification shall be correct, clear, and identifiable. The audio levels of the Morse code and voice shall sound similar. The course structure shall not be affected by the identification.

b. Voice. Voice transmissions (when installed) shall be clear and understandable. Simultaneous voice transmissions and Morse code identification shall sound similar. The voice identification shall be suppressed during voice transmissions. Voice transmissions shall not cause more than ± 0.5 degrees of course deviations.

c. Sensing and Rotation. The "To/From" sensing shall be "From" when positioned on a selected radial, and the bearings shall decrease in a counter clockwise direction around the station.

d. Modulation Levels.

(1) 30 Hz AM shall be 30 ± 5 percent.

(2) 30 Hz FM shall be 30 ± 5 percent or 16.0 ± 1.2 when expressed as a deviation ratio.

(3) 9960 Hz shall be 20 to 35 percent on transmitters with voice modulation and 20 to 55 percent on transmitters without voice modulation.

e. Polarization. The effects of polarization shall not exceed 2 degrees.

f. Radials. Alignment and Course Structure:

(1) Alignment of all electronic radials shall not exceed ± 2.5 degrees of the correct magnetic azimuth except:

(a) Reference radial alignment shall be established not to exceed ± 1.0 degree of the correct magnetic azimuth.

(b) Deviations of the course due to bends shall not exceed 3.5 degrees of the correct magnetic azimuth and shall not exceed 3.5 degrees from the average electronic radial alignment.

(2) Course Structure:

(a) Roughness/scalloping: Momentary deviations from the on course, from FAF to MAP, shall not exceed ± 3.0 degrees.

(b) Course aberrations. Deviations from the on course greater than 3.0 degrees are acceptable for all other radials, provided the aggregate area does not exceed the following:

1 0.25 nm in any 5 nm segment from sea level up to 10,000 feet MSL.

2 0.5 nm in any 10 nm segment from 10,001 feet to 20,000 feet MSL.

3 1.0 mile in any 20-mile segment above 20,000 feet MSL.

(c) Flyability. The effects of any one, or combination of any alignment and/or course structure criteria, even though in tolerance, shall not render the radial unusable or unsafe.

g. Signal Strength. Signal strength is satisfactory when the received RF signal equals or exceeds $5\mu\text{V}$ or -93 dbm .

h. Receiver checkpoints.

(1) Airborne receiver checkpoints. All parameters shall meet tolerances, and the alignment shall be within ± 1.5 degrees of the published azimuth.

(2) Ground Receiver Checkpoints. All parameters shall meet tolerances except the minimum acceptable signal strength is $15\mu\text{V}$ (-83 dbm) and the alignment shall be within ± 2.0 degrees of the published azimuth.

(3) See paragraph 201.52i(3).

i. Monitor. The transmitter azimuth monitor reference shall be ± 1.0 degree.

j. Standby Equipment. The standby transmitter shall meet all tolerances, and the difference in azimuth alignment between transmitters shall not exceed 2.0 degrees.

k. Standby Power. Operation on standby power shall not cause any parameters to exceed tolerances.

l. Associated Facilities. Reserved.**201.52 TACAN/DME Tolerances**

a. Identification. Code identification shall be correct, clear, distinct, without background noise, and not affect course characteristics throughout the coverage limits of the facility. TACAN/DME identification shall be correctly sequenced with the VOR identification when collocated as a VORTAC.

b. Sensing and Rotation. Sensing and rotation shall be correct.

c. Distance Accuracy shall be within 0.25 nm plus 1.25 percent of the slant distance.

d. Radials. Alignment and course structure:

(1) Alignment of all approach radials shall not exceed ± 2.0 degrees of the correct magnetic azimuth.

(2) Alignment of all other electronic radials shall not exceed ± 2.5 degrees of the correct magnetic azimuth.

(a) Reference radial alignment shall be established not to exceed ± 1.0 degree of the correct magnetic azimuth.

(b) Deviations of the course due to bends shall not exceed 3.5 degrees of the

correct azimuth and shall not exceed 3.5 degrees from the average electronic radial alignment.

(3) Course structure:

(a) Roughness/scalloping: Momentary deviations from the on course, FAF to MAP, shall not exceed ± 3.0 degrees.

(b) Course aberrations. Deviations from the on course greater than 3.0 degrees are acceptable for all other radials, provided the aggregate area does not exceed the following:

1 0.25 nm in any 5 nm segment from sea level up to 10,000 feet MSL.

2 0.5 nm in any 10 nm segment from 10,001 feet MSL to 20,000 feet MSL.

3 1.0 nm in any 20 nm segment above 20,001 MSL.

(c) Flyability. The effects of any one, or combination of any alignment and/or course structure criteria, even though in tolerance, shall not render the radial unusable or unsafe.

(4) Unlocks.

(a) Approach radials. No condition of azimuth or distance unlock is permitted within the segment of the final approach beginning at the FAF and ending at the MAP. The only exception would be normal passage through the station cone. En route criteria should be applied to all other segments.

(b) En route radials.

(1) No more than one condition of azimuth unlock not to exceed 1 nm in a 5 nm segment and/or condition of distance unlock not to exceed 1/2 nm in a 5 nm segment.

(2) Where airspace procedures depict a 10 DME or greater arc from the station to a final approach radial, en route tolerances shall be applied to both azimuth and range functions except that no conditions of unlock are permitted 5° either side of any radial depicted or proposed for procedural use (i.e., initial approach fix, intermediate approach fix, final approach radial, lead radial, crossing radial, reference point, etc.)

e. DME fixes. See paragraph 201.52c.

f. Orbits. See paragraph 201.3205.

g. Coverage. Coverage shall be at the standard service volume of the facility being checked as determined by existing criteria for terrain and obstacle clearance. Exception — coverage for "T" (Rho Theta) facilities will be 25 miles. The standard recommended signal strength is -80 dbm or higher. However, the lack of -80 dbm shall not be the sole determination for restricting or removing a facility from service if a solid stable DME or azimuth lock-on is present.

h. Frequency Interference. Frequency interference shall not derogate facility performance to the extent that the pilot cannot audibly identify the facility or cause out-of-tolerance conditions on the TACAN course and distance information.

i. Receiver Checkpoints.

(1) Airborne Receiver Checkpoint. Course alignment shall be within ± 1.5 degrees of the published azimuth.

(2) Ground Receiver Checkpoints. The ground receiver checkpoints must meet the following tolerances:

(a) Course alignment must be within ± 1.5 degrees of the published azimuth.

(b) Distance indication must be within 0.2 miles of the measured distance.

(3) Inability of the facility to provide a ground or airborne receiver checkpoint according to the tolerances specified above shall not cause a restriction to be placed on the facility.

j. Monitor. The transmitter azimuth monitor reference shall be ± 1.0 degree.

k. Polarization Effect. The maximum deviation of the course caused by the effects of horizontal polarization is ± 2.0 degrees.

l. Standby Equipment. Operative standby and primary equipment will meet the same tolerances. The difference in the alignment of the course formed by each transmitter shall be within 1.5 degrees. Distance differential between transmitters shall not exceed 0.2 miles.

m. Standby Power. Tolerances for a facility on standby power shall be the same as those on primary power.

n. Associated Facilities. The tolerances contained in other appropriate sections of the manual are applicable to associated facilities.

201.53 SHIPBOARD TACAN

a. Introduction. Flight inspection of shipboard TACAN shall be performed when requested by the U.S. Navy. Due to the deployment of ships, these inspections shall be considered a one-time inspection and shall include all checklist items in paragraph 201.5301.

b. The flight inspection shall be scheduled upon receipt of the following information:

(1) Date and time of requested inspection.

(2) Name and hull number of the ship.

(3) TACAN channel.

(4) UHF primary and secondary communication frequency.

(5) Location of ships (latitude and longitude).

(6) Name and phone number (FTS and/or AUTOVON) of area coordinator.

c. The inspection shall be conducted with the ship underway and at a distance from shore that is sufficient to preclude interference or shielding of the signal by land mass during radial and orbital inspections.

d. The ship's radar shall be used as a basis to determine alignment. Fire control radar is considered the most accurate and will be used when available. Search (CIC) radar may be used if fire control radar is not available. Fire control information is given as TRUE bearings, and search radar is MAGNETIC.

e. Due to various antenna mount positions on ships and possible shielding by other antennas, masts, etc., nulls, and/or unusable sectors may occur. Suspected out-of-tolerance conditions shall be confirmed by a second evaluation of the area in question. Any sector of the TACAN that does not provide azimuth or distance information shall be reported immediately to the ship and documented in the flight inspection report.

201.5301 CHECKLIST. The following shall be inspected during shipboard inspections.

- a. Identification.
- b. Sensing and rotation.
- c. Polarization.
- d. Radial alignment (minimum of one).
- e. Coverage.
- f. Distance accuracy.
- g. Frequency interference.
- h. Alignment orbit.
- i. Approach radial.
- j. Standby equipment.
- k. Stabilization.

l. Checks will be completed in accordance with appropriate paragraphs of this section unless modified or changed by the following:

(1) Those items normally inspected during radial flight may be accomplished on a radial to or from the ship or during inspection of the approach radial.

(2) Identification. Shipboard TACAN identification consists of two Morse code letters transmitted every 30 or 37 1/2 seconds.

(3) Coverage. Check a minimum of one radial for coverage to 40 nm during inbound or outbound flight at 700 MSL. Advise the ship if coverage is less than 40 nm.

(4) Frequency Interference. All of the ship's electronic equipment that is normally operating should be activated during the inspection.

(5) Alignment Orbit. The orbit shall be flown beyond 7 nm from the ships and no lower than 700 feet MSL. On those ships using search radar (CIC) for alignment, the orbit shall be flown below 2,000 feet MSL.

(6) Approach Radial. The ship's approach radial is that radial that will guide the aircraft to the stern of the ship and will vary depending on the heading of the ship. Fly the radial from a minimum of 7 nm and 700 feet MSL to pass over the ship at 300 feet MSL. Determine and report radial alignment and structure.

(7) Standby Equipment. CV, LPH, LHA, and LPD ships have dual TACAN equipment. Spot check the standby equipment during radial flight by requesting a change from primary to standby equipment.

(8) Equipment Stability. Stability of the TACAN equipment may be effected during a turn of the ship. Stability will be checked during radial inspections by requesting the ship to turn left 15 degrees and then right 15 degrees. Advise the ship's personnel of any change to azimuth or alignment during the turns.

(9) Demand Mode. RESERVED.

201.5302 TOLERANCE. The tolerance contained in paragraph 201.52 will apply as appropriate to the shipboard TACAN.

SECTION 202. VOR TEST FACILITY (VOT)

202.1 Introduction. This section describes the procedure and tolerances used to inspect and certify a VOT. A VOT is a facility which transmits a test signal that is used to determine the operational status of a VOR receiver. A "Standard VOT" is a facility intended for use on the ground. It should be checked on the ground in the area of intended use. An "Area VOT" is a facility designed for use on the ground or in the air. It may be located to provide the test signal to one or more airports. Certification of an area VOT shall be based on checks of facility performance in all areas of intended use.

202.2 Preflight Requirements. At this time VOT's do not have a specified service volume. VOT service is identified and controlled by the FAA regional office having jurisdiction of the airport where VOT service can be provided. Area VOT's are strategically installed to serve certain specific airports on the ground. Additional airports may be identified by the appropriate regional office to receive airborne VOT service. The inspector shall inspect those airports identified to receive ground and/or airborne service. If, as a result of the inspection, adequate VOT coverage is found at additional airports, the FAA regional Office shall be notified. If they concur that the additional airports should receive VOT service, then the inspector shall publish the additional airports.

202.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with paragraph 106.21.

202.22 Flight Personnel. Prepare for flight inspection in accordance with paragraph 106.22. The flight inspector shall also:

a. Research the possibility of replacing hard-to-get-at or time-consuming VOR ground checkpoints with area VOT service.

b. Determine if VOT service can be provided by present standard VOT's at satellite airports where no present service is provided.

c. Coordinate with the appropriate regional Flight Standards representative; e.g., FIP staff, prior to replacing a receiver checkpoint with VOT service, or prior to authorizing VOT service at a satellite airport.

d. Assure that the regional Frequency Management office has approved the proposed areas/altitudes before authorizing area use.

202.3 Flight Inspection Procedures. Recordings shall be made on all flight inspections to provide graphic data for analysis of signal intensity and station performance. Record crosspointer, flag alarm current, identification, and AGC on all checks.

202.31 Checklist. Perform the checks as noted below. Periodic requirements may be performed either on the ground or in the air within the areas approved for use.

Check	Ref. Para	C	P
Spectrum Analysis	202.3201	X	X
Identification	202.3202	X	X
Sensing	202.3203	X	X
Modulation Level	202.3204	X	X
VOT Reference Point	202.3205	X	
Alignment (Course Indication)	202.3206	X	X
Coverage	202.3207	X	X
Monitor	202.3208	X	
Standby Power	106.43	X	

202.32 Detailed Procedures. Airborne procedures do not apply if the VOT is not identified for airborne use.

202.3201 Spectrum Analysis. Evaluate the electromagnetic spectrum using a spectrum analyzer if interference is suspected. Record the measured frequency and detailed information on observed interference.

202.3202 Identification. The purpose of this check is to assure that the correct tone and identification are transmitted.

Two means of identification are used with these facilities, either a continuous series of dots, or a series of dots that cannot be interpreted as Morse code. Facilities maintenance personnel should be consulted for the proper identification. Record the commissioned identification on the facility data sheet.

Approved Procedure. For both standard and area VOT's, check and record the identification for correctness, clarity, and possible effects on the course indications throughout the areas of intended use (both in the air and on the ground).

202.3203 Sensing. This check determines and/or establishes the correct ambiguity of the transmitted signal.

Approved Procedure. While on the ground or in the air, check that the ambiguity indicates TO with 180° set in the omnibearing selector (OBS) and FROM with 360° set in the OBS, throughout the areas of intended use.

202.3204 Modulation Level. Since minor variations of the 30Hz AM, 30Hz FM, and 9960 will effect flight data, check the modulation levels throughout the areas of intended use. Measure and record modulation levels during all inspections.

Approved Procedure.

(1) Ground. Establish nominal values at the VOT reference point. Ensure that modulations remain within tolerance throughout all use areas.

(2) Airborne. Ensure that modulations remain in tolerance throughout all areas while conducting coverage maneuvers.

202.3205 VOT Reference Point. This check provides a designated area to begin an inspection or verify facility performance. The reference point shall be documented on the facility data sheet.

Approved Procedure

(1) Standard VOT. This check should be performed on the ground. Position the aircraft in an area of normal use for the VOT. It is recommended that the area chosen be the furthest distance from the facility maintaining line of site. Ensure signal quality and alignment are satisfactory in accordance with paragraph 202.5. When ground measurements are not practical, use the procedures outlined in paragraph 202.3205(2) to establish the reference point.

(2) Area VOT. This check may be performed on the ground or in the air. Position the aircraft over a known geographical point at the furthest point of intended use from the facility while maintaining line of site. Ensure signal

quality and alignment are satisfactory in accordance with paragraph 202.5.

202.3206 Alignment. This check is performed to establish and/or verify the accuracy of the transmitted VOT courses throughout the coverage areas.

Approved Procedure. Establish the VOT course alignment at its optimum value (zero degree course error) at the VOT reference point.

(1) Commissioning. Use the procedure described in paragraph 202.3205(1).

(2) Periodic. Inspect the alignment of the VOT anywhere within the approved use areas. If the station alignment exceeds the tolerances specified in paragraph 202.5, recheck and reestablish the alignment (and monitors if necessary).

202.3207 Coverage. The purpose of this check is to ensure that adequate signal is received in all areas of intended use.

a. Approved Procedures.

(1) Standard VOT. Coverage is evaluated during a commissioning inspection concurrent with establishing the standard VOT Reference Point (see paragraph 202.3205(1)). For periodic inspections, evaluate coverage anywhere within the approved use area.

(2) Area VOT. Identify all the airports that the area VOT is to serve. Evaluate VOT performance at these airports in the air and/or ground, depending on air or ground use.

(a) Ground coverage is evaluated during a commissioning inspection concurrent with establishing the area VOT Reference Point (see paragraph 202.3205(2)). For periodic inspections, evaluate coverage anywhere within the approved area.

(b) Airborne Coverage. Airborne coverage is evaluated during the commissioning inspection concurrent with establishing the approved use area. Since there is no standard service volume, the area is predicated on the need for VOT service, facility performance, and frequency protection. The most beneficial service can be provided by establishing an approved use area which is a fixed radius around the VOT site, normally 10 to 15 miles. An alternative to this method would be to fly a

separate 3-mile orbit around each airport where VOT service will be provided.

(c) **Inspections.** During the commissioning inspection, fly the orbits at the minimum and maximum altitudes at which VOT use will be authorized, normally between 1,000 and 5,000 feet. On periodic inspections, evaluate facility performance anywhere within the approved use area.

b. **Restrictions to Coverage.** Notify appropriate airport personnel of any areas within line-of-sight of the VOT in which sufficient signal is not available, then comply with paragraph 107.3

202.3208 Monitor. This check assures that a valid course is transmitted within specified values. For flight inspection purposes, the remote alarm unit shall be considered a part of the monitor.

Approved Procedure. Conduct this check at the VOT reference point or at any point on the airport where a valid signal is received.

(1) Have facilities maintenance personnel shift the course until the alignment monitor alarms. Record and measure the course.

(2) Have facilities maintenance personnel shift the course in the opposite direction until the alignment monitor alarms. Record and measure the course.

(3) Have facilities maintenance personnel return the course to normal. Record and measure the course.

202.3209 Standby Power. See paragraph 106.43.

202.4 Analysis. See paragraph 106.5.

202.5 TOLERANCES.**VOT GROUND USE AND AREA SERVICE**

Parameter	Reference Para	Inspection		Tolerance/Limit
		C	P	
Spectrum Analysis	202.3201	X	X	Interference shall not cause any out-of-tolerance condition.
Identification	202.3202	X	X	Correct, clear, without background noise. Readable throughout area of coverage. Identification shall not affect course characteristics.
Sensing	202.3203	X	X	TO with OBS set at 180°. FROM with OBS set at 360°.
Modulation Level 30 Hz AM, 30 Hz FM (3) and 9960.	202.3204	X	X	30% ± 5%.
Alignment	202.3206	X	X	0.0° 1.0° or less.
Coverage (1)	202.3207			
Ground (Normal use areas)		X	X	15 µV minimum.
VOT Reference point	202.3205	X	X	15 µV minimum
Air		X	X	15 µV minimum throughout those areas/altitudes approved for use.
Monitor	202.3208	X	(2)	The course alignment monitor shall alarm when the course shifts exceed 1.0°.
Standby Power	202.3209	X		Signal strength, modulations, and course deviation remains within normal tolerances.

(1) If the aircraft receiver is capable of measuring exact flag alarm current, apply a tolerance of 240 µA flag to all "coverage" checks.

(2) Check when alignment is found out-of-tolerance.

(3) When the 30 Hz signal is reported as a deviation ratio, the tolerance is 16 ± 1.2.

SECTION 207. LOW AND MEDIUM FREQUENCY

NONDIRECTIONAL BEACONS (NDB)

207.1 INTRODUCTION.

a. Low and medium frequency beacons transmit nondirectional signals on a continuous carrier keyed with either 400 or 1,020 Hz amplitude modulated Morse code identification. The carrier frequency bands are 190 to 535 kHz and 1,600 to 1,800 kHz.

b. Nondirectional Beacons are classified according to their intended use. The classifications are:

- (1) Compass Locators (LOM, LMM)
- (2) MH Facility
- (3) H Facility
- (4) HH Facility

207.2 PREFLIGHT REQUIREMENTS.

207.21 Facilities Maintenance Personnel shall prepare for the specific inspection according to the procedures outlined in Section 106.

207.22 Flight Personnel. The flight crew shall adhere to the procedures outlined in Section 106. For a commissioning inspection, the flight inspector shall prepare a chart with the facility plotted and orbit depicted.

207.3 FLIGHT INSPECTION PROCEDURES. Flight inspection of the facility determines the facility coverage and quality of the signal. The flight inspector shall verify the accuracy of the Morse code identifier and check for interference during all inspections.

207.31 Checklist.

Type Check	Ref. Para	C	P
Identification	207.3201	X	X
Voice	207.3202	X	X
Coverage	207.3203	X	
	207.3204b		X
Standard Instrument Approach Procedure	207.3204a	X	
	207.3204b		X
Station Passage	207.3205	X	X
Standby Transmitter	207.3207	X	
Standby Power	207.3208 106.43	X	

207.32 Detailed Procedures.

207.3201 Identification. The flight inspector shall monitor the Identification during the evaluation for clarity and interference throughout the intended service volume.

207.3202 Voice. When installed, the voice feature enables the Nondirectional Beacon to transmit messages such as weather reports and observations. The flight inspector shall verify the ability of the appropriate ground station to control these broadcasts and to select or de-select this feature.

207.3203 Coverage. During commissioning inspections, coverage shall be evaluated on an orbit with radius equal to the area of intended use per paragraph 207.5c(1). Commissioning will be at a reduced power level determined by facility maintenance. The flight inspector shall fly the orbit at 1,500 feet above the facility elevation except where terrain, obstructions, or hazards to flight interfere. Where terrain interferes, fly the orbit at 2,000 feet above the terrain. Evaluate obstructions or hazards for impact on intended procedures and advise the Procedure Specialist. Evaluate the signal for excessive needle oscillation, weak or garbled ident, and interference throughout the entire orbit. Coverage at distances greater than the orbit radius will be certified for specific routes or transitions. The flight inspector shall fly intended routes or transitions at the minimum altitudes and maximum distances as depicted in the flight procedure document. For satisfactory performance, the facility shall meet the tolerances in paragraph 207.5. If the facility does not support the procedure, the flight inspector shall determine the minimum altitudes and maximum distances that meet all the tolerances in paragraph 207.5 and forward this information to the Procedure Specialist.

207.3204 Standard Instrument Approach Procedure (SIAP).

a. **Commissioning Inspection of SIAP.** The flight inspector shall check all proposed instrument procedures to ensure compliance with tolerances in paragraph 207.5. The flight inspector shall follow the procedures for inspection of SIAP's contained in chapter 214 of this manual. The flight inspector shall make every effort to fly the procedure as the Procedure Specialist depicted, noting human factor elements and flyability. The flight inspector has the discretion to reject the procedure if in his/her opinion it does not constitute a satisfactory maneuver from a pilot or human factors vantage. The flight inspector shall make recommendations to the Procedure Specialist to correct for flyability and human factors noted during the initial inspection. For a commissioning flight inspection, the flight inspector shall ensure the facility complies with the tolerance of 207.5b and shall note the maximum distance that voice can be recognized as a baseline for future inspections.

b. **For a periodic inspection,** evaluate the final approach segment of the standard instrument approach procedure (SIAP).

207.3205 Station Passage. Evaluate the area over the facility for correct indication of station passage. Needle reversal should occur when the aircraft passes directly over or in very near proximity to the station. If an indication of false station passage occurs during any evaluation, the facility shall be NOTAMed out of service and the cause investigated. Momentary needle hunting while over the station will not be construed as false passage.

207.3206 Expanded Service Volume (ESV's) on commissioned facilities may be established at normal power.

207.3207 Standby Equipment. At facilities where dual transmitters are installed, the flight inspector shall check each for a commissioning inspection. The flight inspector shall also verify that the control station has transmitter selection capability.

207.3208 Standby Power. Refer to paragraph 106.43.

207.4 ANALYSIS.

a. **Primary Means of Evaluation.** The stability of bearing indications and the facility coded identification are the primary means of evaluating the Nondirectional Beacon.

b. **Incorrect Bearing Indications.** Erroneous bearing indications may have various causes, including weather phenomena, terrain, and radio interference. Analysis should encompass identification of anomaly cause when possible.

c. **Application of Tolerances.** The tolerances in this section are based on average atmospheric conditions. The flight inspector is expected to use good judgment in differentiating between facility performance and unusual atmospheric phenomena. To establish good facility performance baselines, commissioning flight inspections should be conducted in weather conditions that will not derogate or enhance facility performance.

207.5 TOLERANCES. Nondirectional Beacons that meet tolerances throughout the area of intended use are classified as UNRESTRICTED. Facilities that do not support routes or transitions outside of coverage as listed in paragraph 207.5c(1) will not be restricted, but use of the facility for that purpose will be denied.

a. **Morse Code Identification.** All facilities shall have a Morse code identifier that is correct, clear, and identifiable throughout the area of intended use, including any route or transition that may extend beyond the normal service volume. If the Morse identifier is augmented with voice identification, the voice shall adhere to the same tolerance as the associated Morse identifier.

b. Voice Transmission. Broadcast information shall be clear and recognizable for a minimum of two-thirds of the Nondirectional Beacon's usable distance.

c. Usable Distance.

(1) The minimum usable distance shall be:

- | | |
|---------------------|-------|
| (a) Compass Locator | 15 nm |
| (b) MH Facility | 25 nm |
| (c) H Facility | 50 nm |
| (d) HH Facility | 75 nm |

(2) Maximum bearing deviation:

20 degrees (\pm 10 degrees).

d. NDB Approach. Bearing indicator deviation in the final approach segment shall not exceed:

10 degrees (\pm 5 degrees)

e. Bearing Tolerance Deviation. Short duration, out-of-tolerance needle activity (including repetitive events) will be allowed when either:

(1) the duration does not exceed four seconds on an approach (flown at a nominal 130 knot ground speed), or

(2) the duration does not exceed eight seconds for en route use;

but only if the out-of-tolerance activity cannot be construed as a station passage, and the activity is not generally one-sided when repetitive.

f. Station Passage. Station passage indications shall occur over the ground facility.

g. Standby Equipment. If installed, standby equipment shall perform to all tolerances in this section.

207.6 ADJUSTMENTS. Requests for adjustment shall be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance shall be rechecked by flight inspection.

207.7 RECORDS AND REPORTS. Records and reports are to be completed per Section 108 of this manual and appropriate sections of FAA Order 8240.36, Instructions for Flight Inspection Reporting (latest revision).

207.71 NOTICES TO AIRMEN. Notices to Airmen will be issued when necessary, per Section 107 of this manual.

b. Voice Transmission. Broadcast information shall be clear and recognizable for a minimum of two-thirds of the Nondirectional Beacon's usable distance.

c. Usable Distance.

(1) The minimum usable distance shall be:

- | | |
|---------------------|-------|
| (a) Compass Locator | 15 nm |
| (b) MH Facility | 25 nm |
| (c) H Facility | 50 nm |
| (d) HH Facility | 75 nm |

(2) Maximum bearing deviation:

20 degrees (\pm 10 degrees).

d. NDB Approach. Bearing indicator deviation in the final approach segment shall not exceed:

10 degrees (\pm 5 degrees)

e. Bearing Tolerance Deviation. Short duration, out-of-tolerance needle activity (including repetitive events) will be allowed when either:

(1) the duration does not exceed four seconds on an approach (flown at a nominal 130 knot ground speed), or

(2) the duration does not exceed eight seconds for en route use;

but only if the out-of-tolerance activity cannot be construed as a station passage, and the activity is not generally one-sided when repetitive.

f. Station Passage. Station passage indications shall occur over the ground facility.

g. Standby Equipment. If installed, standby equipment shall perform to all tolerances in this section.

207.6 ADJUSTMENTS. Requests for adjustment shall be specific. The flight inspection crew will furnish sufficient information to enable maintenance personnel to make adjustments. Adjustments which affect facility performance shall be rechecked by flight inspection.

207.7 RECORDS AND REPORTS. Records and reports are to be completed per Section 108 of this manual and appropriate sections of FAA Order 8240.36, Instructions for Flight Inspection Reporting (latest revision).

207.71 NOTICES TO AIRMEN. Notices to Airmen will be issued when necessary, per Section 107 of this manual.

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SECTION 208. UHF HOMING BEACONS

208.1 Introduction

a. The UHF Homing Beacon (AN/URN-12) ground station transmits a continuous carrier in the frequency range of 275 to 287 megacycles, modulated with a 1,020-cycle tone for identification purposes. The power output is approximately 15 watts.

b. The pilot of an aircraft equipped with the AN/ARA-25 or similar equipment can determine the relative bearing of, and "home" on, the facilities maintenance equipment. The airborne equipment extracts the information from signals received by the AN/ARC-27 or similar UHF communications receiver. The relative bearing of the signal source is indicated on a course indicator. Best results are obtained under straight and level flight conditions.

208.2 Preflight Requirements

208.21 Facilities maintenance personnel should prepare for flight inspection in accordance with procedures outlined in Section 106.21.

208.22 Air. The flight inspector will prepare for the flight inspection in accordance with procedures outlined in Section 106.22. In addition to the above preparations, the flight inspector will:

a. Be sure that an approved type of airborne equipment is installed and has been calibrated and aligned in accordance with current FAA directives.

b. On a suitable type of chart, scale 1:500,000 or greater, plot the exact location of the facility. Plot a series of check points spaced approximately 45° apart at a radius between 20 and 30 nm from the station. Determine the primary air routes that are served by the facility and plot the routes on the chart. Select two courses for a long-distance check. Note: These two courses may be extensions of the primary air routes previously selected, but should be at least 45° apart.

208.3 Flight Inspection Procedures. The primary object of the flight inspection is to determine the coverage and quality of the transmitted signal; therefore, it is necessary that

the aircraft be flown through normal usage patterns and procedures to determine the usability of the facility and to ensure that the homing beacon meets the operational requirements for which it was installed.

208.31 Checklists.

Type Check	Reference Paragraph	C	P
Station identification	208.3201	X	X
Bearing accuracy	208.3202	X	X
Voice	208.3203	X	X
Coverage	208.3204	X	X
Long Distance	208.3205	X	X
Low approach	208.3206	X	X
Station passage	208.3207	X	X
Standby equipment	208.3208	X	X
Standby power	106.43	X	

208.32 Detailed Procedures.

208.3201 Station Identification. Select the proper frequency and check for correct identification and tone of the signal. Any discrepancies noted should be reported to maintenance personnel for corrective action before continuing the flight inspection. Note any frequency interference from other stations.

208.3202. Bearing Accuracy. Fly either inbound or outbound over the check points selected in accordance with Section 208.22 and along the primary air routes served by the facility. Fly at minimum instrument altitudes or at an altitude to ensure adequate signal strength. Check the accuracy of the bearing obtained from the airborne receiver against the values obtained from the aeronautical chart.

208.3203 Voice. If the facility is equipped with voice feature, this feature should be checked at maximum usable distance. It will be noted that most types of airborne equipment will require the receiver function selector to be placed in the RECEIVE position to receive voice transmissions. Request a long voice transmission and note the voice quality, modulation, and freedom from interference. In the event voice transmissions do not reach the maximum usable range, return inbound until they can be received satisfactorily. Record this distance on the flight inspection report.

208.3204 Coverage

a. Proceed outbound along one of the primary air routes at minimum instrument altitude until reaching 45 nm or until any out-of-tolerance condition is observed. This position will be the usable distance. Upon completion of the investigation of the first route, proceed to the remaining routes and repeat the above procedures.

b. During the check, observe the surrounding terrain and note the location of terrain, or other obstructions that may prevent line-of-sight transmissions to an area beyond the obstructions. Reflections of radio signals, or shadow effect, caused by the intervening terrain, or other obstacles, may result in bearing errors or loss of usable signal.

c. If areas of weak signal are encountered or if terrain obstructions exist, investigate the areas in question and record the areas checked, location of apparent obstructions, and the minimum altitude and distance at which a usable signal can be received.

208.3205 Long-Distance Check. Proceed outbound along one of the air routes or courses selected to a distance of 100 nm at an altitude of 10,000 feet. Observe and record the extent of the pilot's direction indicator needle oscillation, AGC, and the station identification. Then proceed to the other air route or selected course at the 100-mile range and fly inbound along this route to the facility site, again noting the identification, AGC, and needle oscillation.

208.3206 Low Approach. If this facility is to be used as a low approach aid, a low approach will be made for each of the proposed or approved procedures. Check each approach procedure for flyability. Unusual conditions noted will be further investigated.

208.3207 Station Passage. Fly over the antenna site and note the position where station passage is indicated. The station passage should be indicated by a sharp positive reversal of the pilot's direction indicator needle. No specific tolerances are established for station passage; however, it should be encountered approximately over the facility. Any area where the needle has a tendency to reverse itself before actually passing over the station should be plotted on the chart and reported on the flight inspection report.

208.3208 Standby Equipment. Standby equipment will be spot-checked to ascertain that it meets the same tolerances as the primary equipment.

208.4 Analysis

a. From the data obtained during the flight inspection, the flight inspector must determine if there are any areas where the facility fails to meet the coverage and/or bearing tolerance. If such areas were noted during the flight inspection, he should analyze all data to determine if such effects are caused by terrain or equipment. Normally this facility cannot be expected to give reliable information at ranges and altitudes which are below line of sight.

b. The airborne ADF equipment (AN/ARA-25) is an attachment applied to the UHF transceiver to enable it to take bearings on a transmitted signal. While in the ADF position, the ADF antenna seeks a null in the process of presenting a bearing. Under these conditions, very little signal from the transmitter is applied to the UHF transceiver, and tone identification cannot be heard at distances greater than 70 nm, line of sight, but may be heard at shorter distances depending upon the ambient electrical noise level of the airborne ADF system. (The antenna drive mechanism develops a 100-cycle signal that is great enough to blanket the tone identification except at close range to the transmitter.) Continuous switching from the RECEIVE to ADF position must be accomplished in order to monitor both the identification and the ADF indications.

c. The bearing indicator normally hunts plus or minus a few degrees of the received bearing when the transmitter is operating satisfactorily. In the absence of a carrier, the bearing indicator usually rotates slowly and continuously over 360° of azimuth, or remains stationary. For this reason, the station must be monitored intermittently in the RECEIVE and ADF position.

208.5 Tolerances. All UHF Homers will meet these tolerances for an UNRESTRICTED classification. Classification of the facility based on flight inspection results is the responsibility of the flight inspector.

a. Identification. Station Identification will be correct, clear, and intelligible.

b. Bearing Error.

(1) maximum bearing error will not exceed $\pm 5^\circ$.

(2) ADF needle oscillation will not exceed $\pm 5^\circ$.

c. Voice. If provided, will be clear and readable at distances equal to or greater than two-thirds of the maximum usable distance of the facility.

d. Coverage. Usable distance will not be less than 45 nm at minimum instrument altitude. Coverage is based on the following minimum signal strength with all other parameters in-tolerance. Signal strength shall be 10 μ v or more as indicated by receiver AGC with the receiver function selector in the RECEIVE position.

Coverage limits may be determined by any one or a combination of the above factors.

e. Low Approach. Each approach procedure shall be flyable from a user standpoint.

f. Station Passage. At all altitudes, the needle reversal shall occur approximately over the ground facility. (Any condition of false reversal attributable to the ground facility shall require a notice to airmen.)

g. Standby Equipment. Standby equipment will meet the same tolerances as specified for the primary equipment.

208.6 Records, Reports, and Notices to Airmen. (See Section 108.)

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SECTION 211. COMMUNICATIONS

211.1 INTRODUCTION. Air/ground communications services within the NAS are classified according to function. En route communications (ECOM) is the service provided between ARTCC controllers and pilots, and includes RCAG and BUEC facilities. Terminal communications (TCOM) is the service provided between approach and departure controllers and pilots in terminal airspace, including RCF and ATCT facilities. FSS communications (FCOM) is the service provided between FSS and pilot and are advisory in nature, such as EFAS. Other advisory services include ATIS, AWOS, and ASOS, all of which may be transmitted on a NAVAID or a discrete communications frequency.

211.2 Preflight Requirements. The flight inspector shall prepare for the flight inspection in accordance with the procedures outlined in Section 106. Coverage requirements, including tailored sector definitions, shall be provided by local facility maintenance and air traffic personnel.

211.3 Flight Inspection Procedures. The performance of communications facilities is accurately predicted by computer aided modeling. Therefore, commissioning inspections are only required when requested by facilities maintenance engineering. Periodic inspections shall be conducted on a surveillance basis in conjunction with evaluation of associated navigation and air traffic control facilities.

211.31 Checklist.

Type Check	Reference Paragraph	C	P
TCOM	211.32011	1	2
ECOM	211.32012	1	2
ATIS	211.32013	1	2
AWOS/ASOS	211.32014	1	2

FOOTNOTES:

1. When requested.
2. Surveillance inspections conducted during other inspection evaluations.

211.32 Detailed Procedures.

211.3201 Coverage. When coverage cannot be predicted by facility engineering, a flight inspection will be requested. Evaluate facilities where the minimum en route altitude (MEA) is determined by communications coverage.

a. **During requested commissioning inspections,** coverage shall be determined by the air traffic service requirements established locally.

b. **Flight profiles** may vary according to the local requirements and could include an orbit or a detailed sector evaluation. Communications for fixes, hand-off positions, changeover points, or controlled airspace shall be checked.

c. **Additional frequencies** assigned to the same service requirement will not require a complete inspection, but should be evaluated on a surveillance basis.

d. **Light Gun Signals** shall be checked for adequate coverage on the ground and in flight.

e. **Standby equipment** shall be checked during any requested commissioning inspection.

211.32011 Terminal Communications (TCOM) includes tower, ground control, clearance delivery, departure, arrival, and light gun communications. Commissioning inspections, when requested, shall be conducted at the extremities of the airport to determine if there are blind spots and adequate coverage. Departure and arrival frequencies shall be checked to verify service throughout the established sector volume.

211.32012 En route Communications (ECOM) includes VHF and UHF air/ground frequencies and BUEC channels. When requested, these frequencies shall be evaluated throughout the established sector service volume.

211.32013 Automatic Terminal Information Service (ATIS) broadcast on a NAVAID facility shall be commissioned and reported with that NAVAID (see Section 201). When commissioning is requested, ATIS broadcast on a discrete communications frequency shall be checked in accordance with local requirements. Departure ATIS shall be verified at the airport extremities.

211.32014 Automated Weather Observing System (AWOS)/Automated Surface Aviation Observing System (ASOS). These systems provide local weather observations and may be broadcast on a NAVAID or a discrete VHF communications frequency. Transmission on a NAVAID shall be verified in accordance with Section 201 or 207. Local altimeter settings from these systems can result in lower minimums for standard instrument approach procedures. Whenever this occurs, ensure that the associated procedure has been flight inspected to the new minimum prior to publication. When AWOS/ASOS is used as the primary airport altimeter source, flight inspection shall verify reception at or before the initial approach fix (IAF).

211.4 Analysis. Unsatisfactory conditions shall be brought to the attention of the appropriate air traffic control and facilities maintenance personnel.

211.5 Tolerances.

a. Maximum Recommended Coverage. Communications frequencies are engineered for distinct volumes of airspace which are guaranteed to be free from a preset level of interference from an undesired source. Each specific function has its own frequency protected service volume. Some are cylinders and others are odd multi-point geometric shapes. These odd shapes are normally required for en route ATC services. Following is a table of maximum altitude and radius dimensions recommended for each type of service. Under no circumstance will a service volume be approved at an altitude and distance greater than the radio line of sight (RLOS) distance (reference Figure 303-1).

Service	Maximum Dimensions	
	Altitude	Distance
ECOM		
Low Altitude	surface to 23,000	60
Intermediate Altitude	11,000 to 25,000	60
High Altitude	24,000 to 35,000	150
Ultra-High Altitude	35,000 and above	150
TCOM		
Ground Control	100	5
Clearance Delivery	100	5
PAR (Military)	5,000	15
Helicopter	5,000	30
Local Control	25,000	30
Approach Control	25,000	60
Departure Control	25,000	60
ATIS		
Arrival	25,000	60
Departure	100	5
AWOS/ASOS	10,000	25
NAVAID	Section 201 or 207 At or before the IAF	
Discrete Comm		

b. Local Requirements. Communications service volume requirements are established by the controlling Air Traffic facility based on local operational requirements. When a flight inspection is requested, these local requirements shall be validated and adjusted, if necessary, for satisfactory operation. Communications shall be clear and readable.

c. Light Gun Requirements.

(1) Ground. Ensure adequate coverage for operational control of ground traffic.

(2) Air. Three miles in all quadrants at the lowest traffic pattern altitude.

211.6 Adjustments. All requests for facility adjustments shall be specific. Flight inspection certification shall be based on facility performance after all adjustments are completed.

211.7 Reports. Reports shall be prepared in accordance with Order 8240.36, Instructions for Flight Inspection Reporting (latest version).

211.8 Records and Notices to Airmen (NOTAM). See Section 107.

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SECTION 212. DIRECTION FINDING STATIONS (DF)

212.1 Introduction. Direction finding stations use normal VHF or UHF communication transmissions from aircraft to determine bearing information from a ground station. Facilities maintenance personnel may then relay this information to an aircraft in flight to assist in determining the aircraft position. Doppler type VHF/DF is the standard equipment within the FAA. Older equipment, such as U.S. Navy VHF and UHF/DF facilities, may still be in use at certain locations. Operational performance and flight inspection procedures are the same for all DF equipment, with minor tolerance differences as noted in paragraph 212.5. AFIS is the accuracy standard, but non-AFIS equipped aircraft with suitable communication equipment may perform DF inspections when operated in accordance with appropriate sections in this manual. Direction Finding stations are normally located at or near airports and/or Flight Service Stations. Many DF facilities have the capability of providing an emergency instrument approach procedure where favorably sited with respect to an airport. Assuring the accuracy of these procedures is an integral part of the DF flight inspection.

212.2 Preflight Requirements

212.21 Facilities maintenance personnel shall prepare for flight inspection in accordance with procedures specified in Section 106. For commissioning inspections, facilities maintenance personnel should:

a. **Prepare a detailed outline** of any special information or procedure(s) desired as an outcome of the flight inspection;

b. **Prepare the desired sequence** for the inspection;

c. **Optimize the facilities equipment.**

d. **Ascertain that fully qualified operators and maintenance technicians are available.**

212.22 Flight Personnel shall prepare for the DF flight inspection in accordance with procedures specified in Section 106. Air crews shall:

a. **For commissioning inspections**, prepare a chart with the DF facility accurately plotted and appropriate radials and a 360 ° orbit drawn. The scale of the chart should be 1:500,000 (Sectional) or larger and the areas to be overflown evaluated per Section 214.

b. **Obtain information from facilities maintenance personnel** pertinent to the planned inspection, including desired outcomes, expected performance, and sequence of events.

c. **For periodic inspections**, obtain previous flight inspection data pertinent to the planned inspection.

212.3 Flight Inspection Procedures. The aircraft must be positioned precisely to determine bearing accuracy and service area. AFIS has the positioning capability to the accuracy standard required. Non-AFIS aircraft may perform the inspection if accurately plotted ground check points are selected and the aircraft can be safely maneuvered over these checkpoints. Where neither AFIS nor ground check point positioning is available, the theodolite shall be used. The DF operator will be briefed to compute all bearings as from the DF facility except for station passage and approach procedures.

212.31 Checklist. All of the checks listed below shall be performed on the commissioning flight inspection. Special flight inspections may require any one or all of these checks, depending on the reason for the inspection. Periodic inspection of bearing accuracy will be conducted in conformance with paragraph 212.32025.

Type of Check	Reference Paragraph	C	P
Preliminary Station Alignment	212.3201	X	
Bearing Accuracy	212.3202	X	X
Alignment Orbit	212.32021	X	X
Communication and Coverage	212.3203	X	X
Station Passage	212.3204	X	
Operator Performance	212.3205	X	
Standby Power	212.3206	X	
DF Approaches	212.3207	X	

212.32 Detailed Procedures.**212.3201 Preliminary Station Alignment.**

a. **Use AFIS and select an azimuth from the DF facility to establish an alignment reference.** For non-AFIS aircraft, use the theodolite on a pre-determined azimuth or select a checkpoint which lies within the quadrant of the planned orbit containing the maximum number of checkpoints. At an altitude which will assure radio line of sight, obtain a DF bearing from the operator and compare this bearing with the actual bearing determined from AFIS, the theodolite, or checkpoint.

b. **If the DF bearing error is less than $\pm 6^\circ$,** continue an orbital flight for at least 90° of azimuth. Non-AFIS aircraft will orbit in the direction of the maximum number of checkpoints; theodolite or AFIS orbit direction is at the discretion of the flight inspector and/or DF operator. If the remaining bearings in this primary quadrant are within $\pm 6^\circ$, proceed with the bearing accuracy check as required in paragraph 212.3202. If the reference or succeeding DF bearings in this primary quadrant exceed $\pm 6^\circ$ error, the equipment shall be adjusted and the procedure repeated. From the preliminary check, data should be derived to balance the overall error curve.

212.3202 Bearing Accuracy.

a. **DF coverage** will not substantially exceed line-of-sight. Coverage is dependent on power output, antenna height, terrain, and the effects of signal reflection. The bearing accuracy check is conducted to determine the ability of the DF facility to furnish accurate bearings throughout the service area during commissioning, and forms the reference for other inspections. This is done by comparing DF bearings from the facility with bearings measured from AFIS, theodolite, or ground checkpoints.

b. **If communications become unsatisfactory, or if bearing errors exceed tolerance,** climb above the altitude being flown until adequate communications are established again and/or bearing errors are satisfactory.

c. **If communications and bearing accuracy remain satisfactory on the next measurement,** descend to the appropriate selected altitude or to the minimum altitude which will provide satisfactory bearings and communications, whichever is higher, and continue to the next checkpoint. This procedure will provide the lowest altitudes throughout the coverage area of the DF facility at which acceptable bearing information and communication can be expected.

212.32021 AFIS Alignment and Orbit.

a. **Proceed to the range appropriate to the facility and to the altitude previously determined.** If HYBRID Mode is not available, use the minimum DME update altitude and plan to fly a second orbit for coverage if the minimum DME update altitude is higher than the intended use altitude. The AFIS will be programmed for the DF facility parameters (Identification, Latitude, Longitude, Magnetic Variation) inserted in the FI FAC series.

b. **For initial facility alignment (reference), the AFIS system will be programmed for an RNAV Radial flight path, Inbound or Outbound,** beyond 10 nm from the DF antenna. DF bearing accuracy may be determined by comparing the operator DF bearing to the bearing displayed on the CDU. RNAV/Autopilot coupled flight is recommended for Radial or Orbit maneuvers.

c. **After the initial alignment has been accomplished,** an Orbit CW or CCW will be programmed and flown. An event mark will be made on the recording at the position the transmitter is keyed for the DF steer; comparison can then be made to the 5° bearing marks on the analog recording.

212.32022 Theodolite Orbit.

a. **The theodolite shall be aligned to read magnetic bearings from the DF station.** It should be located adjacent to the DF site at a position where the aircraft will be visible throughout as much of the orbit as possible. This position should be less than 300 feet from the site. The flight inspector should brief the DF operator and the theodolite operator to avoid confusion during the actual flight inspection.

b. **The theodolite operator** shall track the aircraft throughout the orbit and actuate one event mark (1020 Hz tone) at each 10 degrees of azimuth. The pilot shall transmit for a DF bearing at frequent intervals and actuate the pilot event mark on the opposite side of the recording during each such transmission. The airborne technician shall label each of these event marks. The leading edge of the theodolite event mark will represent the actual bearing of the aircraft from the station, and the pilot event marks will represent the DF bearing. The airborne technician will label the DF bearing as reported by the DF operator and determine the error with the use of proportional ("Ten Point") dividers.

212.32023 Checkpoint Orbit

a. **Position the aircraft over the predetermined checkpoints.** Where possible, these checkpoints should be located at or near the limits of the DF and communication range capability to validate bearing accuracy and service area simultaneously. As the aircraft approaches the first ground checkpoint or measured bearing, the pilot shall transmit a 10-second radio signal, timed so that the aircraft will be over the checkpoint in the middle of the transmission. Compare the bearing provided by the DF operator with the measured magnetic bearing. Note each DF bearing, magnetic bearing, error, radio frequency, altitude, and distance on the flight inspection report. Bearing errors shall be computed in the same manner as VOR course alignment errors; i.e., when the aircraft bearing is less than the bearing reported by the DF operator, the error is negative.

b. **Proceed with the orbit of the facility at the appropriate range and altitudes,** obtaining bearings as often as practical. After initial contact has been established, a 5 to 10 second radio signal is usually sufficient to obtain bearings. Because of the capability of almost instantaneous readout on the Doppler type DF, a five-second radio signal is usually sufficient to obtain bearings on this type facility.

212.32024 Analysis of Bearing Accuracy. After completing the bearing accuracy check, station adjustment may be necessary to balance station error and keep all bearings within tolerance. Whenever bearing errors are very large in a particular area and normal elsewhere, it may be advisable to investigate the area further by checking radially or by partial orbits at different ranges. When an out-of-tolerance condition cannot be corrected, the controller shall be advised of the area(s) which are not to be used.

The condition(s) will be noted on the flight inspection report and the facility assigned a "restricted" classification. A NOTAM will not be issued.

212.32025 Periodic Inspections will include a bearing accuracy check at a minimum distance of 20 nm and at a minimum altitude of 1500 feet, an altitude which will provide obstacle clearance in the area, or radio line of sight, whichever is highest. A minimum of one bearing check shall be accomplished on each published frequency and, if available, the VHF emergency frequency.

212.32026 Commissioning Inspection

a. **An orbit procedure, as outlined in paragraph 212.32, shall be used to evaluate bearing accuracy for the commissioning flight inspection.** Orbit radius shall be the minimum of:

- (1) 40 miles for Doppler DF facilities;
- (2) 30 miles for older equipment;
- (3) operational requirements

The altitude shall be 1500 feet AGL, or the minimum altitude which will provide 1,000 feet of obstacle clearance (2,000 feet obstacle clearance in designated mountainous areas) in the area within 5 nm of the orbit, or the minimum altitude which will provide radio line of sight, whichever is the higher.

b. **AFIS or theodolite bearings** may be taken at frequent intervals as close together as 10°. A minimum of four bearings shall be taken for each quadrant, regardless of which orbit method is used.

212.3203 Communications and Coverage.

Voice communication is the means for getting DF information to a pilot. Quality of communications greatly affects the capability of the DF to provide quality service. Bearings shall be obtained on as many of the published frequencies as practical during the checkpoint orbit. For a commissioning inspection, all frequencies proposed for use will be checked. This may be accomplished on the orbit or during radial flight at the extremes of coverage. For periodic inspections, voice communications will be checked on all frequencies if less than four are used for DF bearings. If more than four are available, at least four frequencies will be checked. The VHF emergency frequency, if available, shall be evaluated during all flight inspections. Where coverage is required at greater distances for special purposes, it can be determined by either orbital or radial flight at the greater distance and altitude.

212.3204 Station Passage. Fly inbound to the DF antenna from a position at least 5 miles out and an altitude of 1500 feet above the antenna. Obtain sufficient steers from the DF operator to overfly the antenna and note the distance from the aircraft to the DF antenna when the operator reports station passage. This check may be performed in conjunction with the DF approach procedure (Paragraph 212.3207) at the discretion of the pilot and DF operator.

212.3205 Operator Performance. The flight inspector must determine that the overall system is safe and reliable. The operator should be able to direct the aircraft over the facility, report station passage, and provide pertinent information relative to the use of DF service. If an emergency approach procedure has been established (DF approaches are not SIAPs), the operator should be able to direct the aircraft to a position from which a safe landing can be made.

212.3206 Standby Power.

a. **Standby power, if installed, shall be checked on the commissioning inspection** to ensure that no derogation of communication or bearing accuracy occurs when using the alternate power source. An orbit on each source will be performed and the bearing accuracy and overall station error compared. If standby power is installed at a later date, the facility will be inspected on standby power at the first periodic inspection scheduled after the installation of the standby power system. Inspections after a change in the standby power source are at the discretion of the Airway Facilities Engineering Division.

b. **Periodic inspections normally will not require the use of standby power systems.** Airway Facilities personnel may request a check on standby power if they suspect that the alternate power source causes a deterioration in the performance of the DF facility.

212.3207 DF Approaches.

a. **The emergency DF approach shall be checked at the time of commissioning.** Airway Facilities personnel or DF facility operators may request a check of the approach during any inspection if, in their opinion, verification of the procedure or equipment performance is desired.

b. **Conduct the approach in accordance with the DF operator's instructions and evaluate the obstacle clearance and flyability per Section 214.** The flight inspector shall note the position of the aircraft relative to the airport

and determine whether it will permit a safe landing.

212.4 Standby Equipment. Where installed, standby equipment will meet the same operational tolerances during commissioning as the primary equipment. Periodic inspection of standby equipment is not required unless requested by Airway Facilities, Engineering, or the DF operator.

212.5 Tolerances. All DF stations shall conform to these tolerances for an UNRESTRICTED classification. Classification of the facility is the responsibility of the flight inspector.

a. **Bearing Accuracy**

VHF/DF, UHF/DF: Each DF bearing must be within 10° of the actual bearing.

VHF/DF (doppler): Each DF bearing must be within 6° of the actual bearing

b. **Coverage**

VHF/DF UHF/DF: 30 miles

VHF/DF (doppler): 40 miles

c. **Communications.** Communications on all required frequencies shall be clear and readable throughout the coverage area.

d. **Station Passage.** Station passage must be recognized within 1 1/2 miles at 1500 feet AGL.

e. **Controller Performance.** Controllers shall be capable of directing an aircraft to the station, reporting station passage, providing guidance for an emergency approach, and vectoring aircraft to avoid terrain and obstacles.

f. **Standby Power.** The DF facility will meet all tolerances in this section when operating on an alternate power source.

g. **Emergency Approaches.** Where a DF approach procedure is established, the system shall provide the capability of directing the aircraft to a position from which a safe landing can be made.

212.6 Adjustments. Equipment adjustment shall be made to balance the overall station error.

212.7 Records, Reports, and Notice to Airmen. For commissioning flight inspections, a graphic representation of the course error (error curve) shall be constructed and included as part of the flight inspection record. The commissioning error curve and the original map(s) used to plot the DF facility, DF approaches, and terrain and obstacles will be included in the permanent facility file. (See Sections 107 and 108).

SECTION 213. GLOBAL POSITIONING SYSTEM (GPS)

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SECTION 213. GLOBAL POSITIONING SYSTEM (GPS)

213.1 INTRODUCTION. This Section details the flight inspection procedures and tolerances to be applied to Global Positioning System (GPS) approach procedures.

213.11 GPS SYSTEM DESCRIPTION. The Global Positioning System (GPS) is a Department of Defense (DoD) operated global coverage, satellite-based navigation system. It provides standard positioning service (SPS) to all equipped users plus precision position service (PPS) to DoD specially equipped users, and other specially equipped users.

GPS is an Earth Referenced Navigation (ERN) system that uses earth models (datums) to determine position on the surface of the earth. The coordinate system provided by the GPS signal is the Cartesian Earth-centered Earth-fixed coordinates as specified in the DoD Defense World Geodetic System 1984 (WGS-84).

GPS consists of three distinct functional segments; the space segment, control segment and user segment.

The space segment consists of 21 satellites, plus three active spares that are deployed in six orbital planes (with 4 in each plane) at approximately 11,000 miles above the earth. The space segment provides the signal structure necessary for user equipment to determine time and a position fix in terms of latitude, longitude, and altitude as required. The GPS constellation broadcasts a pseudo-random code timing signal and data message that the airborne equipment processes to obtain satellite position and status data. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the airborne receiver can accurately measure the time each signal takes to arrive at the receiver and determine aircraft position.

The satellites radiate on two frequencies; L1 at 1575.42 MHz and L2 at 1227.6 MHz. The satellites transmit their signals using spread spectrum techniques, employing two different spreading functions: a 1.023 Mbs coarse/acquisition (C/A) code on L1 and a 10.23 Mbs precision (P) code on both L1 and L2 transmitted in phase quadrature. Total

bandwidth around each carrier is 20.46 MHz. Superimposed on both the C/A and P-code is the navigation message containing satellite ephemeris data, C/A to P-code hand-off, atmospheric propagation correction data, and satellite clock-bias information. This data is transmitted at 50 bps. The minimum power level (signal strength) available at the output of the user antenna is -160 dBW.

The GPS control segment is responsible for monitoring the status of each satellite and updating the navigation data transmitted by each satellite. This segment consists of the master control station, five monitoring stations, and three uplink antenna facilities. Satellite information is transmitted from the monitor stations to the master control station. The master control station uses this information to update the contents of the navigation data via the ground uplink antennas.

The user segment consists of antennas and receiver-processors onboard the aircraft that provide position, velocity, and precise timing to the user. The GPS receiver calculates a position fix using a ranging technique. The user equipment determines the pseudo-ranges from at least four satellites to calculate the receiver's internal clock offset and the three-dimensional position fix. The signal transmitted by each satellite is modulated with data that defines the satellite's position (ephemeris), the GPS system time, its clock error and the health and accuracy of the transmitted data. The user equipment is able to decode this information and determine where the satellite is located at any given time (pseudo-range).

Selective Availability (SA) is a method by which the DoD can artificially create a significant clock and ephemeris error in the satellites. This technique is designed to deny any enemy the use of precise GPS position data. SA is the largest source of error in the GPS system. When SA is active, the DoD guarantees horizontal position accuracy of the SPS will not be degraded beyond 100 meters 95 percent of the time and 300 meters 99.99 percent of the time. All SPS system performance specifications assume SA is active.

213.2 PREFLIGHT REQUIREMENTS (Flight Personnel). The flight inspector shall prepare for the flight inspection in accordance with the procedures outlined in Section 106.

213.3 FLIGHT INSPECTION PROCEDURES

213.31 Nonprecision Approach Checklist

Type Check	Ref. Para.	C	P
Initial/Intermediate Approach Segment	213.321	X	
Final Approach Segment	213.321	X	X
Missed Approach Segment	213.321	X	
SIAP	214.3	X	X

213.32 Detailed Procedures. GPS non-precision approach procedures consist of sequenced waypoints. The entire flight plan of waypoints (IAWP to MAHWP) will be entered into the GPS receiver for commissioning flight inspections and selected from the GPS receiver data base for periodic inspections..

213.321 Terminal Segments (IAWP, IWP, FAWP, MAWP, MATWP, MAHWP).

a. Purpose. To evaluate the waypoint data accuracy and GPS position determination throughout the area comprising the standard instrument approach procedure. The Initial Approach Segment (IAS) begins at the Initial Approach Waypoint (IAWP) and ends at the Final Approach Waypoint (FAWP). These points may be defined by the same coordinates in some procedure designs. The Final Approach Segment (FAS) begins at the FAWP and ends at the Missed Approach Waypoint (MAWP). The Missed Approach Segment (MAS) begins at the MAWP and may include turning or holding waypoints (MATWP or MAHWP) or fixes from ground-based navigation aids.

b. Positioning.

(1) IAS evaluation may be performed when flying by the waypoint if it is depicted as a turn point on the procedure.

(2) IAS and MAS shall be flown at procedural altitudes.

(3) The FAS positioning shall be such that all waypoints depicted in a straight line are evaluated by flying over the waypoint and evaluating GPS positioning determination and

delivery alignment. Position the aircraft to fly from three miles outside the first waypoint in a straight line (normally an IWP or FAWP) and overfly all waypoints to the MAWP. Final approach segments shall be flown to 100 feet below the published altitude from the FAWP to the MAWP.

c. The automated flight inspection system (AFIS) or the portable GPS flight inspection system (GFIS) shall be the standard for the final approach segment evaluation.

d. Evaluation.

(1) During commissioning flight inspection, terminal approach segment data integrity shall be evaluated by comparison of procedural waypoint data to the flight plan waypoint data entered into the flight inspection GPS system by database or the pilot. Prior to the approach being flown, the flight plan data shall be compared to the procedural data to ensure bearings and distances between waypoints reflect the procedure design.

(2) The AFIS will correct between the FAWP and MAWP if position updates are used.

213.4 FLIGHT INSPECTION ANALYSIS

213.41 Procedural/Design Data Base Integrity. The procedure shall be evaluated to verify the geodetic coordinates (waypoints) are correct. AFIS will display the bearing and distance from each waypoint to the next in the flight plan. These values shall be compared to the procedural design and shall meet the requirements of Paragraph 213.5.

213.42 Standard Instrument Approach Procedure (SIAP). The instrument flight procedure shall be evaluated to ensure flyability and safety. This evaluation and analysis shall be performed in accordance with Section 214, throughout the procedure, including the missed approach segment.

213.43 Position Determination. WPDE is the vector sum of ATKER and XTKER. WPDE for each segment waypoint shall be evaluated to verify accuracy with the procedural design and the tolerance in Paragraph 213.5. WPDE for the FAWP and MAWP will be calculated by AFIS from corrected data. WPDE for other waypoints will require the use of raw data.

213.44 Other Parameters. The following parameters shall be recorded during all phases of flight inspection.

Parameter	Expected Value
HDOP	4.0 maximum
HFOM	835 ft./255 meters
Satellites tracked (PRN)	4 minimum
SNR	30 dB/Hz minimum

There are no flight inspection tolerances applied to these parameters. However, the values listed above provide a baseline for analysis of any GPS signal anomalies or interference encountered.

213.45 Electromagnetic Spectrum. The RF spectrum from 1200 to 1250 MHz and 1555 to 1595 MHz should be observed when GPS parameters indicate possible RF interference. Interfering signals are not restrictive unless they affect the receiver/sensor performance. The SNR values being recorded may indicate RF interference problems. The normal GPS signal strength is -130 to -123 dBm. Use the SNR values along with the spectrum analyzer to investigate the RF interference, the location of its occurrence, and possible sources. Particular attention shall be given to harmonics on or within 20 MHz of GPS L1 (1227.6 MHz) and those on or within 10 MHz of GPS L2 (1575.42 MHz). Report any electromagnetic spectrum anomalies or suspected anomalies encountered to the Program Director for Spectrum Policy and Management.

213.5 TOLERANCES. During final approach evaluation, GPS performance shall meet the following tolerances:

Parameter	Ref. Para.	Tolerance/Limit
Initial/Inter. Approach Segment		
Database Integrity	213.41	
True Bearing to next WP Distance to next WP		$\pm 2^\circ$ ± 0.5 nm
WPDE (Raw data)	213.43	1700 ft.
Final Approach Segment		
Database Integrity	213.41	
True Bearing to next WP Distance to next WP		$\pm 2^\circ$ ± 0.3 nm
WPDE (Corrected data)	213.43	835 ft.
Missed Approach Segment		
Database Integrity	213.41	
True Bearing to next WP Distance to next WP		$\pm 2^\circ$ ± 0.5 nm

213.6 Records, Reports, and Notices to Airmen. See Sections 107 and 108.

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SECTION 214. FLIGHT INSPECTION OF INSTRUMENT FLIGHT PROCEDURES

214.1 INTRODUCTION. Instrument flight procedures specify standard routings, maneuvering areas, flight altitudes, and visibility minimums for instrument flight rules (IFR). These procedures include airways, jet routes, off-airway routes, standard instrument approach procedures (SIAP), standard instrument departure procedures (SIDs), standard terminal arrival routes (STARs), and procedures predicated on the use of Flight Management Systems (FMS) and Global Positioning System (GPS). All new and revised procedures are subject to flight inspection.

214.2 PREFLIGHT REQUIREMENTS

a. The office initiating the procedure shall forward all data necessary for conducting the flight inspection to the Flight Inspection Central Office (FICO) who in turn will forward the information to the flight inspector responsible for the inspection. If there are special factors relative to the procedure, the FICO shall set up a briefing by the procedures specialist, or designee, for the flight inspector.

b. Procedural data shall include the following as a minimum:

(1) Charts of sufficient detail to safely navigate and identify considerable terrain, obstacles, and obstructions (e.g., 1:500,000 for en route procedures, 1:100,000 for terminal procedures);

(2) Documentation of all known terrain, obstacles, and obstructions in the primary areas with the map study/data base determined controlling subject identified; secondary obstructions shall be identified if the object or terrain impacts the procedure;

(3) Minimum (and maximum where applicable) altitudes determined to be usable from map study and data base information for each segment of the procedure;

(4) Narrative description of the procedure;

(5) Plan and profile views for SIAPs;

(6) Data for each fix, intersection, and holding pattern;

(7) Communication applicable to each segment of the procedure;

(8) Airport marking and any special local operational procedure (e.g., noise abatement, non-standard traffic patterns, lighting activation).

c. Current forms are acceptable from established organizations involved in the development of instrument procedures. If the procedures package as delivered to the FICO is inconsistent with this section, the package will be returned intact to the developing organization. If, after the package is sent to the flight inspector, it is found to be inconsistent with this section, the flight inspector shall return it intact to the FICO who shall return it to the developing organization. The FICO/flight inspector shall identify deficiencies on a comment sheet to accompany the returned procedures package.

d. Two copies of the procedure will be provided to the FICO. One copy shall remain at the FICO until the flight inspection is completed, then it will be destroyed or forwarded as requested. The second copy goes to the crew, which may make copies of all or portions of the procedures package at their discretion to distribute to crew members.

214.3 FLIGHT INSPECTION PROCEDURES

a. The objective of evaluating instrument flight procedures is to ensure safety and flyability. The following items are included in this evaluation:

(1) Aircraft maneuvering is consistent with safe operating practices for the category of aircraft intending to use the procedure.

(2) Cockpit workload is acceptable.

(3) Navigation charts properly portray the procedure and are easily interpreted.

(4) Runway markings, lighting, and communications are adequate.

(5) The applicable system (NAVAID, Satellite, FMS, etc.) supports the procedure.

References in this section are for clarification purposes only and do not supersede instructions or flight inspection criteria for facilities or systems contained elsewhere in this order.

b. A restricted NAVAID may still support an instrument flight procedure when the procedure does not use the out-of-tolerance area. Those areas shall be reflected on the flight inspection report and on the navigation charts where performance will restrict or limit the expected procedure.

c. A distance measuring equipment (DME) arc segment may be used in areas of unusable radial information, provided that the DME, the radial where the arc starts, the lead radial, the final approach radial, and any other radial used in the procedure meet required tolerances.

d. The flight inspection of an instrument flight procedure and verification of the SIAP obstacle data may be conducted during the applicable system inspection if visual meteorological conditions (VMC) prevail throughout each segment of the procedure to be evaluated.

e. Verification of Obstacle Clearance

(1) Identification of New Obstacles. In most instances, accurate information concerning the location, description, and heights of tall towers and other considerable obstacles is available from the FAA data base and/or other government sources. When a new obstruction not identified in the procedures package is discovered and may become the controlling obstruction for the segment, the procedure commissioning will be denied until the procedure specialist can analyze the impact of the obstacle on the overall procedure.

(2) Obstacle Locations shall be noted in latitude/longitude as determined from a flight inspection receiver (e.g., GPS), or radial/bearing and distance from a known facility. If these methods are not available, an accurate description on the flight inspection map may be used.

(3) Estimation of Obstacle Heights.

(a) When a new obstacle not identified from current data base information is discovered, the flight inspector will ascertain via the safest and most expeditious method available the location and height of the new obstruction and forward the information to the procedure specialist listed on the request for flight inspection cover sheet. Obstacle heights measured in flight will not be used unless the actual height of the obstruction cannot be determined by other means. If inflight height determination is required, accurate altimeter settings and altitude references must be used to obtain precise results.

(b) An alternative method for determining obstacle height is to select another obstacle in the near vicinity which has a known or published elevation. Fly abeam the uppermost point of the known obstacle and set the co-pilot's altimeter to read the same mean sea level (MSL) altitude as published. Without resetting the altimeter, fly abeam of the obstacle for which the height is unknown and note the altimeter reading. Where possible, note the AGL elevation for the procedure specialist and any deviation from the above procedure necessary to compensate for unlevel terrain.

(4) The flight inspection report will reflect the documentation for the method of height determination.

(5) Controlling obstacles in each approach segment shall be confirmed visually by inflight or ground observation. If unable to confirm that the declared controlling obstacle is the highest obstacle in the segment, list the location, type, and approximate elevation of the obstacles the flight inspector desires the procedure specialist to consider. The flight inspector will place special emphasis on discovered obstacles that may not be listed in the FAA data base. If the controlling obstacle is listed as terrain/trees or Adverse Assumption Obstacle (AAO), it is not necessary to verify which tree is controlling, only that no higher manmade obstacle is present in the protected airspace. If the flight inspector observes that the controlling obstacle has been eliminated or dismantled, the flight inspector shall forward that information to the procedures specialist.

(6) Conduct obstacle evaluations in visual meteorological conditions (VMC) only. The flight inspector retains the responsibility to ensure that the procedure is operationally safe and may use his/her discretion to vary the pattern to best suit the evaluation. If during a periodic inspection the procedure is flown at night, in IMC conditions, or the flight inspector cannot ascertain the required obstacle clearance (ROC), he/she shall state in the "Remarks" section of the flight inspection report that the obstacle verification was not accomplished and for which SIAP. If the obstacle verification cannot be accomplished either by other ground means or cannot be accomplished during the next periodic inspection, the procedure shall be notamed out of service until the check can be accomplished. During periodic inspections, it is not necessary to visually identify the controlling obstacle but rather to visually verify the integrity of the required obstacle clearance plane for the final and missed approach segment. For precision approaches with sloping obstacle clearance planes, only surveyed data should be used when considering obstructions.

214.31 Checklist.

Check	Ref. Para.	C	P
Final Approach Segment	214.3201	X	
	214.32011	X	X
Missed Approach Segment	214.32012	X	X
Circling Segment	214.32013	X	1
En route/Terminal Segments	214.3202	X	1
Fixes/Holding Pattern	214.3203	X	1
Air/Ground Communications	214.3204	X	1
Area Navigation/GPS/FMS	214.3205	X	2

NOTE:

1. Surveillance.
2. SIAPs require periodic inspection per Section 105.

214.32 Detailed Procedures.**214.3201 Approach Segments**

214.32011 Final Approach. The final approach course shall deliver the aircraft to the desired aiming point. The aiming point varies with the type of system providing procedural guidance and will be determined by the procedure specialist. After flight inspection verifies the aiming point, it will not be changed without the concurrence of the procedure specialist. When the system no longer delivers the aircraft to the established aiming point and the system cannot be adjusted to regain the desired alignment, consideration should be given to amending the procedure.

214.32012 Missed Approach. Flight inspection of the missed approach segment will assure that the designed procedural altitudes provide obstacle clearance per paragraph 214.3e. The flight inspector shall also determine that the procedure is safe and operationally sound for the category aircraft intended.

214.32013 Circling. The flight inspector shall verify that proposed circling maneuvers are safe and sound for the category of aircraft proposed. Procedural altitudes shall be evaluated per paragraph 214.3e.

214.3202 En route/Terminal Routes. Evaluate each en route or terminal segment during commissioning flight inspection to ensure that the proposed minimum obstacle clearance altitude (MOCA) is adequate per paragraph 214.3e.

214.32021 Minimum En route Altitude (MEA) and Changeover Points. The MEA and changeover points shall be predicated on minimum obstruction altitude (MOCA), minimum reception altitude (MRA), airspace, and communication requirements. If more than one of the above altitudes is procedurally required, the highest altitude determined through flight inspection will become the minimum operational altitude.

214.32022 Maximum Authorized Altitudes (MAA). MAAs are limitations based on airspace restrictions, system performance characteristics, or interference predictions. If the MAA are based on an interference problem, the source of the interference must be identified and corrective action initiated where possible.

214.3203 Fixes/Holding Patterns. Controlling obstacles shall be verified to ensure the adequacy of minimum holding altitude (MHA) per paragraph 214.3e. System performance will be evaluated to ensure conformance with appropriate tolerance sections of this manual. If system performance and obstacle clearance data are on file, flight inspection of the procedure is not required.

214.3204 Air/Ground Communications. Air/ground communications with the controlling facility must be satisfactory at the minimum initial approach fix altitude and at the missed approach altitude. Where ATC operations require continuity in communication coverage and ATC requests verification, flight inspection shall evaluate that coverage in accordance with appropriate sections of this order.

214.3205 Area Navigation (RNAV), GPS, FMS. All procedures based on RNAV, GPS, or FMS shall be evaluated by flight inspection for conformance to safe and sound operational practices. Flight inspection of these procedures shall, as a minimum, evaluate the following:

- a. Waypoint accuracy;
- b. Bearing accuracy;
- c. Distance accuracy;
- d. Conformance with paragraph 214.3a;
- e. Obstacle clearance per paragraph 214.3e;
- f. System support of the procedure at altitudes proposed for use.

214.32051 Detailed Procedures

a. **The flight inspector shall review and evaluate each segment** of the procedure for conformance with safe and sound operational practices. Where required, the flight inspector shall coordinate and brief ATC on special handling requirements and procedural operation. Prior to flight, the inspector shall verify that all supporting equipment or systems are in place and functioning (e.g., Rho Theta systems in operation, satellite ephemeral data and availability, etc.).

(1) Waypoint Accuracy. The purpose is to verify that the waypoints as depicted on the procedure are properly labeled and correct. Rho-Theta systems shall properly depict supporting facilities; systems utilizing coordinates are depicted in a manner compatible with equipment requirements. Specific equipment tolerances or displacement errors are addressed in other portions of this order. The procedure will comply with tolerances listed in the appropriate section.

(2) Bearing Accuracy. AFIS is the standard for determining the bearing accuracy to and between waypoints. The procedurally depicted bearings will agree with the bearings announced from AFIS. Where there is disagreement, the procedure will be denied and the procedure specialist advised.

(3) Distance Accuracy. AFIS is the standard for determining the distance accuracy between waypoints. Where there is a difference between depicted waypoints and AFIS, the procedure will be denied and the procedure specialist advised.

(4) The flight inspector shall evaluate all facets of the procedure to ensure compliance with safe operating practices. The evaluation shall include the clarity and readability of the depiction and that workloads imposed on the air crew to select or program the procedure are reasonable and straightforward. Objective and professional judgment from air crews trained in flight inspection is expected.

(5) Runway Markings, Lighting, and Communication. The flight inspector shall evaluate the suitability of the airport to support the procedure. Unsatisfactory or confusing airport markings, non-standard or confusing lighting aids, or lack of communication at critical flight phases are grounds for denying the procedure. In all cases, the procedure specialist will be appraised of the conditions discovered during the flight inspection.

(6) Applicable System Support. The variation in systems dictates a progressive approach in determining evaluation methods. Study of the procedure by the flight crew prior to flight will normally reveal the type of system verification required. Where a ground-based NAVAID supports the procedure, the flight inspector shall verify its status prior to flight. RNAV systems will be evaluated through emulation with AFIS aircraft. Where emulation is not possible, the procedure will be performed in an aircraft certified for the procedure with the flight inspector aboard and in a position where evaluation per paragraph 214.32051a(4) can be accomplished.

b. **En route and terminal route segments** shall be flown at the proposed MEA using the applicable system for guidance and to or from a point where course or obstacle clearance has been established. In the case of a SID, the procedure shall be evaluated to an established NAVAID or fix or to a point where en route obstacle clearance has been established. For STAR type procedures, the route shall be evaluated from where it departs known obstacle clearance and guidance to where the route intercepts a portion of an established SIAP or procedure from which a normal descent and landing can be accomplished. Periodic inspection of en route and terminal route segments is not required.

c. **Standard Instrument Approach Procedures (SIAP).** All standard instrument approach procedures intended for publication shall be inflight evaluated. The final approach trapezoid shall be evaluated per paragraph 214.3e. The final approach segment shall be flown to an altitude 100 feet below the proposed minimum descent altitude. Approaches with precision vertical guidance shall be evaluated to the proposed decision or missed approach altitude. Misalignment or inaccurate data indications will be forwarded to the procedure specialist for further review prior to commissioning the procedure.

214.4 ANALYSIS. Flight inspection determines that the procedure is flyable and safe. If a new procedure is unsatisfactory, the flight inspector shall coordinate with the procedure specialist to determine the necessary changes. When an existing procedure is found unsatisfactory, initiate NOTAM action immediately and advise the procedure specialist.

214.41 Cartographic Standards. Changes to cartographic standards are the responsibility of the Interagency Air Cartographic Committee and the Intra-Agency Committee for Flight Information. Recommendations for changes to these standards should be sent to the Office of Aviation System Standards, Flight Inspection Operations Division, AVN-200, for consolidation and forwarding to the appropriate committee.

214.42 Night Evaluations.

a. For new flight procedures at airports with no prior IFR service, a night flight inspection shall be conducted to determine the adequacy of airport lighting systems prior to authorizing night minimums.

b. Inspect light systems during the hours of darkness. Evaluate the light system for:

(1) Faithful representation of the depiction (correct light pattern);

(2) Operation in the manner proposed (e.g., photocell, radio control etc.);

(3) Local lighting patterns in the area surrounding the airport do not distract, confuse, or incorrectly identify the runway environment.

214.43 Human Factors are concerned with optimizing the relationship between people and their activities by systematic application of human sciences integrated within the framework of systems engineering. In the context of flight inspection, it is a question of whether a flight procedure is operationally safe and flyable for a minimally qualified sole pilot flying an aircraft with basic IFR instrumentation in instrument meteorological conditions using standard navigation charting.

The criteria used to develop instrument flight procedures represent many factors such as positioning requirements, protected airspace, system and avionics capabilities, etc. Human factors such as cockpit workload, pilot error, and memory limitations have been considered. Sensory, perceptual, and cognitive restrictions historically have been incorporated in the criteria only to a limited extent; e.g., length of approach

segments, descent rates, turn angles, etc. These are products of subjective judgments in procedure development and cartographic standards. It is incumbent upon the flight inspector to apply the principles of human factors when certifying an original or amended procedure. The following factors shall be evaluated:

a. Complexity. The procedure should be as simple as possible. It should not impose an excessive workload on a sole pilot flying a minimally equipped aircraft.

b. Interpretability

(1) The final approach course should be clearly identifiable, with the primary guidance system or NAVAID unmistakable;

(2) The procedure should clearly indicate which runway the approach serves and indicate which runway(s) circling maneuvers apply to;

(3) Areas not to be used for maneuvering shall be clearly defined.

c. Human Memory Considerations. Pilots must be able to extract information quickly and accurately during an instrument approach. Multiple tasks complicate the memory process and tend to produce prioritization during stressful phases of flight. Workload reduction can be accomplished through methodical chart layout that encourages the pilot to periodically refer to the depicted procedure rather than trying to memorize complex maneuvers.

214.5 TOLERANCES. The procedure should be safe, practical, and easily interpreted with minimal additional cockpit workload. Supporting facilities/systems shall meet tolerances of the appropriate sections of this manual and not contribute to operational confusion.

214.6 ADJUSTMENTS. See Section 106, paragraph 106.45.

214.7 REPORTS. The flight inspector shall certify that the procedure has been checked and the controlling obstacles verified. The facility/system flight inspection report and the appropriate procedure or SIAP documentation shall be completed.

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SECTION 215. SURVEILLANCE RADAR AND AIR TRAFFIC CONTROL
RADAR BEACON SYSTEM (ATCRBS)

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SECTION 215. SURVEILLANCE RADAR AND AIR TRAFFIC CONTROL

RADAR BEACON SYSTEM, (ATCRBS)

215.1 INTRODUCTION. This section outlines procedures for the flight inspection of surveillance radar and the air traffic control radar beacon system (ATCRBS). The procedures for radar flight inspection differ from the procedures for NAVAID's in that most of the data collection and analysis are conducted on the ground. The flight inspector's role in the radar environment is primarily one of providing a known target in a designated area. Present digital techniques allow the evaluation of many radar parameters by the use of statistical sampling of aircraft returns in the normal day-to-day radar environment. Although certain requirements must be completed using a flight inspection aircraft, facilities maintenance personnel should use targets-of-opportunity, radar data analysis (RDAS) tools, and other test equipment to the extent practicable for completing all checklist requirements. Facilities maintenance personnel will normally evaluate and document all radar facility performance parameters except those specifically evaluated by the flight inspector. Airway Facilities will prepare a radar inspection plan for all commissioning inspections, as well as all special inspections involving coordination outside the facility of concern. Joint use facility (radar data used by both FAA and DOD) inspection plans require coordination between the FAA region and the DOD user.

215.11 Primary Radar. Primary radar relies on reflected radio energy to provide a video target on the controller's display. The radar return varies in strength due to atmospheric conditions, target range, radar cross section, aircraft reflective surfaces, and other phenomena.

215.12 Secondary Radar. Secondary radar, referred to as ATCRBS, overcomes some of the basic problems of primary radar. Secondary radar relies on electronic replies from a transponder system in the aircraft which are generated as a result of interrogations from a ground-based system. Transponder replies can be used for improved target identification (assigned beacon code) and for aircraft altitude information from Mode-C equipped transponders. The ATCRBS normally provides improved coverage over primary radar. As with primary radar, the ATCRBS coverage is a function of many factors; e.g., siting, antenna patterns, etc. Although a separate system, the ATCRBS is normally

inspected simultaneously with the primary radar system.

215.2 PREFLIGHT REQUIREMENTS/INSPECTION PLAN The AF regional maintenance engineering office and/or military equivalent is responsible for preparing the Operational Performance Inspection Plan in accordance with FAA Order 6300.13, Radar Systems Optimization and Flight Inspection. AT and the FICO shall assist in the coordination required for the plan. The plan shall fulfill five major functions: accomplish necessary coordination; list operational requirements; provide the necessary data; provide notification of the event; and establish the inspection schedule. An inspection plan is required for all commissioning radar inspections and special inspections involving pre-inspection coordination outside the facility of concern. Simple special inspections that do not require coordination outside the local AF/Maintenance and AT offices may not require a formal inspection plan but should always be documented. The USAF RADES will participate in the planning and inspections of a JSS site.

215.21 Facilities Maintenance Personnel. The appointee preparing the inspection plan shall coordinate with all associated offices. For en route sites, the attendees shall be: AF representatives from the ARTCC and the remote site, AT representatives from the regional office and the ARTCC, and a FICO representative. The DOD user and appropriate RADES representative should attend planning meetings to identify operational requirements and evaluation objectives for a JSS. For terminal radar inspections, the appointed coordinators shall include AT representatives from the region and local site, an AF representative from the systems maintenance office, and a FICO representative. Military offices shall provide plan preparation and the required coordination for joint use and military sites. The appointee for special plan preparation shall be assisted by representatives from each office of concern. This assistance will be requested from specific offices when required. In addition to the procedures specified in Section 106, facilities maintenance personnel shall ensure the following items are addressed in the inspection plan:

a. The Objectives of the Inspection. These objectives will determine who shall assist and provide input for the draft of the plan and the methods used to perform the various checks and what checks will be performed by facilities maintenance personnel and flight inspection.

b. Prepare a List of Operational Requirements. These requirements shall describe in detail all routes, fixes, holding patterns, and approach and departure procedures. These details shall include specified altitudes, distances, and other pertinent information. The list of routes, fixes, etc., may then be divided between evaluations using targets-of-opportunity and those requiring a flight inspection aircraft. A flight inspection aircraft will normally be used in areas with low traffic activity, where siting criteria predicts marginal or no coverage, or where fix/map accuracy must be determined. The flight inspection phase of the plan may be further divided into checks requiring an aircraft with a calibrated transponder and those which can be completed using a small aircraft equipped with an approved transponder. When assigned to inspect or evaluate a military/JSS facility, the RADES evaluation officer shall perform all coordination and notification requirements, complete the flight phase planning, and publish required documents.

c. Describe the Resources Required. This list shall include personnel, aircraft, special tools and equipment, equipment calibration, computer time and software, charts, graphs, maps, etc. The inspection plan shall also include all data required to prepare, conduct, and document the inspection.

d. Flight Scheduling. Recommend, if appropriate, the best flight period for evaluating coverage. The flight period will usually be a compromise between operational and engineering needs. This compromise is required because AT prefers to handle flight inspection aircraft during periods of low traffic activity; however, the AF engineer may require some portions of coverage checks during peak traffic periods.

e. Radar Equipment Performance. Ensure the radar equipment is tuned to facility operational specifications prior to the flight inspection. A joint inspection is required to measure and optimize JSS equipment parameters.

f. Participating Personnel. Ensure participating maintenance and operations personnel (including military) are experienced and familiar with the objectives of the inspection and the requirements of this order.

g. Inspection Plan Ensure the inspection plan includes a sequence of events to minimize aircraft flight time and the inconvenience to operating traffic. This portion of the plan shall be used as a schedule of events during the inspection activities.

h. Final Plan. Ensure the final plan is reviewed and signed by representatives from AT, the FIO, the military when appropriate, and AF.

i. Consolidated Inspection Data. Consolidate and evaluate all inspection data obtained using targets-of-opportunity and advise the flight inspector of additional checks that require the use of a flight inspection aircraft.

j. Interrogator Calibration Values. Furnish the interrogator power values (in watts at the antenna) for inclusion in the flight inspection report.

215.22 Flight Personnel. Prepare for the flight inspection in accordance with Section 106. In addition:

a. Flight Inspection Coordinator. The FICO shall appoint a qualified flight inspection pilot as coordinator for each commissioning radar inspection, and special inspection as required, in accordance with paragraph 215.21.

b. Inspection Plan. A copy of the inspection plan and a current briefing concerning the operational requirements, expected facility performance, and the performance evaluations obtained using targets-of-opportunity shall be provided to the flight inspector. This information will be used to determine the extent of the flight inspection.

c. Checklist Requirements. Assist facilities maintenance personnel in determining which checklist requirements have been completed. The role of the flight inspector will vary greatly depending upon the type, sophistication, intended use, and location of the radar facility. For instance, an FAA en route radar may only require the flight inspector complete a portion of the vertical coverage check, whereas a mobile terminal radar may require a dedicated aircraft for all the checklist requirements.

d. Aircraft Requirements. Flight inspection aircraft used for ATCRBS and primary radar checks are equipped with a transponder that has been FAA-calibrated in accordance with applicable avionics maintenance standards. The transponder power output and sensitivity are pilot-selectable per the following table.

FLIGHT INSPECTION TRANSPONDER SWITCH SETTINGS		FLIGHT INSPECTION TRANSPONDER PARAMETERS	
Flt Insp Select	Lo-Power Select	Rx Sensitivity	Tx Power
OFF	OFF	Normal (-75 dBm)	Normal (350 watts)
ON (barber pole lit)	OFF	Low (-69 dBm)	Normal (350 watts)
ON (barber pole lit)	ON (barber pole lit)	Low (-69 dBm)	Low (88 watts)

215.3 FLIGHT INSPECTION PROCEDURES

a. General. Radar flight inspections may vary from a single (special inspection) requirement such as radar coverage over a new air traffic "fix," to a complete en route radar commissioning inspection at an ARTCC. The number of personnel, coordination, preparation, and reporting required for inspections varies widely. An inspection normally consists of three distinct parts; planning, engineering, and documentation. The planning phase results in the flight inspection plan. The engineering or equipment phase includes necessary tests to ensure the radar system performs to design specifications. Although this phase is primarily an AF engineering function, some tests may require a flight inspection aircraft. When multiple approved procedures are listed, the AF engineering representative can select which procedure is to be used. The tests required during the engineering phase are referenced in paragraph 215.31, Checklist, and paragraph 215.32, Detailed Procedures. The documentation or flight inspection portion determines if AT requirements are met and establishes a radar coverage baseline. AT requirements are outlined in the facility siting report and the inspection plan. The detailed flight inspection procedures are covered under paragraph 215.32.

b. Commissioning Inspections. The objective of the commissioning inspection is to

evaluate system performance, determine and document the site coverage, and provide a baseline for the detection of a deterioration in equipment performance. Data obtained during this inspection will be used for daily comparison of facility performance, as well as future inspections. The commissioning is the most thorough inspection and requires a correspondingly detailed plan and report.

c. Periodic Inspections. Military ASR's without surveillance approaches and FAA ASR's do not require a periodic flight inspection. ASR's which are operated by the military and have surveillance approaches require a periodic flight inspection of the surveillance approaches.

d. Special Inspections. Special inspections are conducted to fulfill a particular need and may be very limited in scope. The limited inspection may not require a formal written plan, and only a short inspection report. If equipment changes or modifications to commissioned facilities change the coverage pattern, document the changes in the inspection report. The new coverage pattern then becomes the basis for comparison during subsequent inspections. Coordination with appropriate military personnel is vital at joint-use sites. Special inspections include the following:

(1) Engineering Support. Engineering support is performed to help engineering and AT personnel determine if the radar meets equipment certification and operational requirements. This data may be used for commissioning purposes, provided no equipment modifications are made prior to the commissioning inspection. Requirements for specific checks will be determined by facilities maintenance personnel and need not conform to a specific format.

(2) Antenna Change. Paragraph 215.31, Checklist, identifies requirements for the installation of a new antenna of the same or different type. If there is a question concerning the characteristics or type of antenna being installed, the AF engineer in charge will determine which antenna change checklist applies. A flight inspection is not required following an antenna pedestal or rotary joint change, provided the ground measurements of the reflector position, feedhorn alignment, and antenna tilt of the replacement pedestal, are satisfactory. Refer to paragraphs 215.3204d(4) and (5) for antenna change procedures.

(3) **Major Modifications** (other than antenna change). This inspection plan, inspection, and report should be confined to the parameters necessary to confirm facility performance. The radar engineer shall determine the extent of a special inspection during preparation and coordination of the plan. Depending upon the extent of the modification, an inspection using RDAS tools and targets-of-opportunity may satisfy the inspection requirements.

(4) **Near-Midair-Collision Inspections.** These inspections are conducted at the request of the AT manager of the facility involved. The inspection determines the radar coverage in the area where the incident occurred. The flight inspection shall be conducted as soon as possible following the near-midair-collision, duplicating the maneuvers, altitude, and direction of flight of the incident aircraft. The radar shall be operated in the same configuration, to the extent practicable, as it was at the time of the

incident. Near-midair flight inspection reports shall be submitted in the same manner as after-accident reports (see Order 8240.36, Instructions for Flight Inspection Reporting).

215.31 Checklist. The checks requiring a flight inspection aircraft are identified in the checklist and appropriate "detailed procedure" paragraphs. The procedures presented here may be used singly when a special inspection may be satisfied with one or more of the individual tests. The checklist items identified by an "X" are mandatory. Facilities maintenance personnel shall evaluate the data obtained using targets-of-opportunity to determine if further evaluation by a flight inspection aircraft is required. The flight inspector shall consult with the radar engineer prior to departing the area to ensure that all checklist requirements have been completed. The following checklist items must be completed on each primary or secondary radar commissioning inspection.

CHECKLIST

	Para Ref	C	P	Antenna Change				Major Mods	FI Transponder Settings	
				Primary		ATCRBS			Lo-Pwr Select	Flt Insp Select
				Same Type	Diff Type	Same Type	Diff Type			
Orientation	215.3201	X		X	X	X	X	X	OFF	ON
Tilt	215.3202	X			X		X		OFF	ON
Primary Rdr Optim	215.3203									
ATCRBS Optim										
Power	215.3212	X,1					X,1		OFF	ON
SLS/ISLS	215.3210	X					X		OFF	ON
Modes/Codes	215.3211	X							OFF	ON
GTC/STC	215.3213	X					X		ON	ON
Vertical Coverage	215.3204	X			X		X		ON	ON (Below 15,000 ft MSL)
									OFF	ON (Above 15,000 ft MSL)
Horiz Screening	215.3205								OFF	ON
Airways/Route Coverage	215.3206	X,1							OFF	ON
Flx/Map Accuracy	215.3207	X							OFF	ON
Fixed Tgt Ident	215.3208	X							OFF	ON
Surveillance Apch	215.3209	X,1	X,1	X,1	X,1				OFF	ON
Communications	215.3214	X	X						As requested	
Standby Equip	215.3215	X	X						As requested	
Standby Power	215.3216	X							As requested	

NOTES:

C = Commissioning

P = Periodic

X Denotes mandatory check; see text for approved procedure. All other checks are at engineering/maintenance/controller request.

1 Requires Flight Inspection aircraft for final evaluation. All other checks may be accomplished by software analysis using targets of opportunity or radar data acquisition subsystems (RDAS).

215.32 Detailed Procedures.

a. General. Facilities maintenance personnel shall use operational displays for target grading and guidance information. Facilities maintenance personnel shall configure the radar in its lowest usable configuration (the traditional worst case configuration, all enhancements on, may degrade newer "smart" radars to the point that they become unusable). Data from the operational displays and automation diagnostic and analysis programs will determine if the system supports operational requirements. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with a flight inspection aircraft.

b. Evaluation ATCRBS and primary radar shall be evaluated simultaneously throughout the inspection whenever possible. If ATCRBS replies obscure the primary targets, the displayed ATCRBS should be offset slightly to allow evaluation of both replies.

c. Inspection Sequence. The engineer shall ensure the radar facility is operating according to design specifications before any inspection tests begin. The inspection should start with orientation, tilt, and an initial ATCRBS power setting. During installation, the antenna is normally set to the tilt recommended in the siting report and the azimuth is set to a prescribed reference. These settings should provide adequate accuracy for the initial tests. The initial ATCRBS power may be set to either a theoretical value or a setting that will interrogate aircraft at maximum radar range. After refining these preliminary settings and becoming confident in them, the engineer should use targets-of-opportunity to ensure that primary and secondary coverages are at least as good as that required in the overall quality test. Tests which can be completed without using a flight inspection aircraft should be conducted prior to the arrival of the flight inspection aircraft. At joint-use sites, inspection sequence may vary, in order to satisfy the requirements of all agencies concerned.

NOTE: Parameter changes that occur during the flight inspection aircraft evaluation may require a repetition of previously conducted tests.

215.3201 Orientation.

a. Purpose. To verify the radar azimuth corresponds with a known azimuth position and may be conducted with a flight inspection aircraft or ground check.

b. Approved Procedures.

(1) Fly inbound or outbound radially over a well-defined ground checkpoint or position the aircraft using AFIS. The altitude and distance of the checkpoint should be well inside the radar coverage limits.

(2) A radar PE, maintenance beacon, or MTI reflector of known location may be used to determine alignment of the radar azimuth in lieu of a flight inspection aircraft.

c. Evaluation. Compare the azimuth observed by the controller with the magnetic azimuth of the checkpoint.

215.3202 Tilt Verification

a. Purpose. To verify the primary and secondary radar antenna tilt settings are optimum and the mechanical antenna tilt indicators are accurate.

b. Approved Procedure. Facilities maintenance personnel shall direct the aircraft through the heaviest ground clutter within operational areas so the predetermined angle can be evaluated and adjustments made if required. If radar coverage is acceptable and the radar range is satisfactory, complete the remaining portions of the flight inspection. If parameters are not acceptable, it will be necessary to reestablish the antenna tilt angle. In this case, re-accomplish any previously completed flight inspection procedures using the new antenna tilt angle.

c. Evaluation. The tilt selection process considers the interaction of various radar parameters and the final radar system performance. The optimum tilt angle is a compromise between coverage (with/without MTI) over clutter and range coverage.

215.3203 Primary Radar Optimization

a. Purpose. To aid in maximizing the radar's potential. Adjustments in STC, beam gating, receiver sensitivity, pulse width, etc., may improve a radar's performance.

b. Approved Procedure. Facilities maintenance personnel will provide a detailed flight profile.

c. Evaluation. Facilities maintenance personnel will observe the target display and adjust the radar as necessary.

215.3204 Vertical Coverage

a. Purpose. To determine and document the coverage in the vertical plane of the primary and ATCRBS antenna patterns. Evaluate the inner and outer fringes on all primary and secondary radars.

b. Vertical Coverage Azimuth. Choose an azimuth from the radar antenna or coincident VOR/TACAN radial from the radar antenna which is free of clutter, dense traffic, heavy population areas, and interference created by line-of-site obstructions. Conduct the commissioning inspection and all subsequent inspections concerning facility performance, on the same azimuth for comparison purposes. For inspection at altitudes above flight inspection aircraft surface ceiling, Airway Facilities/Air Traffic has the option of using targets of opportunity/RDAS.

c. Configuration: Facilities maintenance personnel shall determine the lowest usable radar configuration. Suggested configurations are as follows:

Antenna Polarization	Circular
Diplex Systems	Simplex mode
Integrators/Enhancers	OFF
Magnetron/Amplatron Systems	Amplatron (See Note)
Video Processor (military mobile radar)	OFF
ASR-9 Display Video	Uncorrelated
ARSR-3:	
Target Threshold:	91
MTI: I & Q	"I"

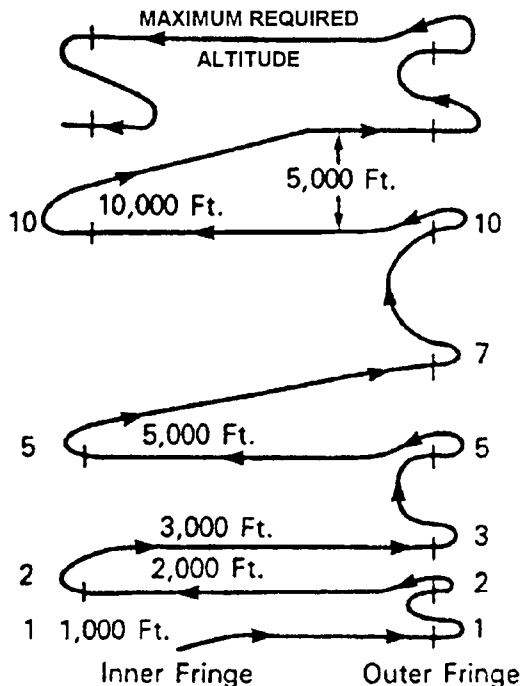
NOTE: At the request of engineering, conduct an additional vertical coverage check for the ARSR 1 & 2 with the amplatron OFF. It is not necessary to conduct the entire vertical coverage; only a spot check of altitudes and ranges, as specified by the engineer.

d. Approved Procedures. Targets-of-opportunity may be used to check the vertical coverage, provided that sufficient targets are present to verify the coverage volume. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with flight inspection aircraft. When using a flight inspection aircraft, determine the outer fringe coverage by evaluating tail-on targets and the inner fringe coverage by nose-on targets. When special requests are made by facilities maintenance personnel to evaluate target returns at the outer fringe with nose-on targets, clearly differentiate between nose-on and tail-on results on the flight inspection report. Aircraft reflective surfaces and transponder antenna radiation characteristics vary between inbound and outbound flight; consequently, differences in coverage can be expected. The flight inspector shall obtain the vertical coverage azimuth and maximum required altitude from the facilities maintenance personnel. Use map checkpoints, a NAVAID radial, AFIS, or radar vectors to remain on the vertical coverage azimuth. Fly all pattern altitudes as height above the radar antenna.

(1) **Commissioning Vertical Coverage Profile, ASR/ATCRBS.** Refer to the Checklist in paragraph 215.31 and to Figure 215-1 and proceed as follows:

Figure 215-1

Commissioning--ASR/ATCRBS Vertical Coverage Profile



(a) Determine the inner fringe at 1,000 feet. Then fly outbound at 1,000 feet and establish the outer fringe.

(b) Climb to 2,000 feet and establish the outer fringe. Then proceed inbound at 2,000 feet and establish the inner fringe.

(c) Climb to 3,000 feet and establish the outer fringe.

(d) Climb to 5,000 feet and establish the outer fringe.

(e) Repeat the outer fringe check at 5,000 feet (or lower if necessary) to evaluate radar auxiliary functions such as linear polarization, pin diode, integrators, etc., on the primary and GTC/STC on the secondary radar. Linear polarization normally increases the usable distance, so this check should be performed at an altitude where the change can be observed. Most auxiliary functions produce a decrease in receiver sensitivity, thereby decreasing the usable distance. Conduct these tests by establishing the outer fringe with the function on, and then off, and noting the difference in usable distance.

(f) Return the equipment to its original inspection configuration and proceed inbound at 5,000 feet and establish the inner fringe.

(g) Climb to 7,000 feet and establish the outer fringe.

(h) Climb to 10,000 feet and establish the outer fringe. Then proceed inbound at 10,000 feet and establish the inner fringe.

(i) If the maximum required altitude is greater than 10,000 feet, check the outer fringe in 5,000 foot increments up to the operational altitude; e.g., if 17,000 feet, check the outer fringe at 15,000 and 17,000 feet, then proceed inbound at the maximum required altitude and establish the inner fringe. If satisfactory radar coverage is not maintained during this inbound run, conduct additional flights through the vertical coverage pattern and establish the maximum usable altitude.

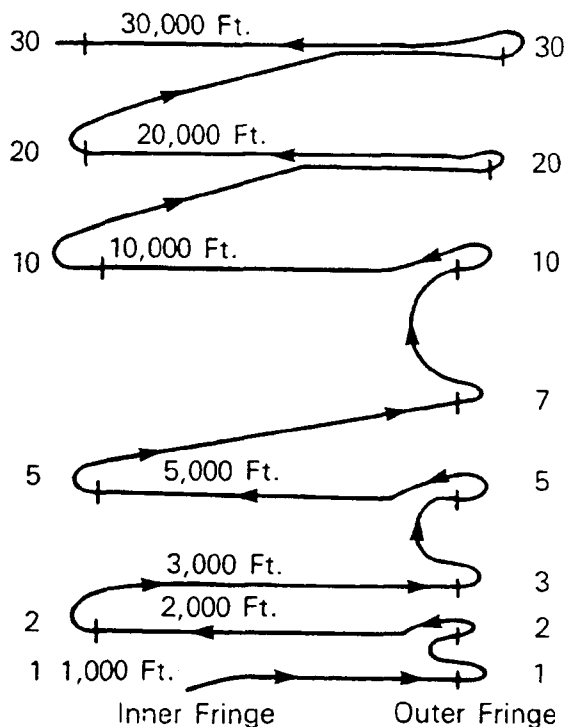
(j) Check the inner fringe at the altitudes used to establish the outer fringe stepping down in altitude to the 10,000-foot level.

NOTE: If the maximum required altitude is 10,000 feet or lower, do not inspect vertical coverage above this altitude unless requested.

(2) Commissioning Vertical Coverage Profile, ARSR/ATCRBS.

Figure 215-2

ARSR/ATCRBS Vertical Coverage Profile



(a) Complete steps (a) through (h) of the ASR commissioning requirements in paragraph 215.3204d(1).

(b) Climb to 20,000 feet and establish the outer fringe. Then proceed inbound at 20,000 feet and establish the inner fringe.

(c) Climb to 30,000 feet and establish the outer fringe.

(d) Repeat the outer fringe as required to conduct auxiliary functions tests.

(e) Then proceed inbound at 30,000 feet and establish the inner fringe.

(f) If operational or engineering requirements are greater than 30,000 feet or 30,000 feet conflicts with air traffic, climb to a mutually agreeable altitude and establish the outer and inner fringes.

(3) Commissioning Inspection - Military BRITE/DBRITE Display. Inspect an ASR which has the sole function of providing a video source for a BRITE/DBRITE display to operational requirements or 4,000 feet/10 miles, whichever is greater.

(a) Determine the inner and outer fringes at every 1,000-foot level up to 4,000 feet or the operational altitude.

(b) No comparative equipment auxiliary function configuration checks are required.

(c) Target definition will be from the BRITE display.

(d) There are no periodic inspection requirements.

(4) Primary Radar Antenna Change. When the primary ASR or ARSR antenna is changed, fly the vertical coverage profile depicted in figure 215-3 or 215-4, as applicable.

(a) After determining the outer fringe at 5,000 feet, repeat the outer fringe check, as required, to evaluate auxiliary functions as requested by facilities maintenance personnel. Conduct the remainder of the coverage check in the original configuration.

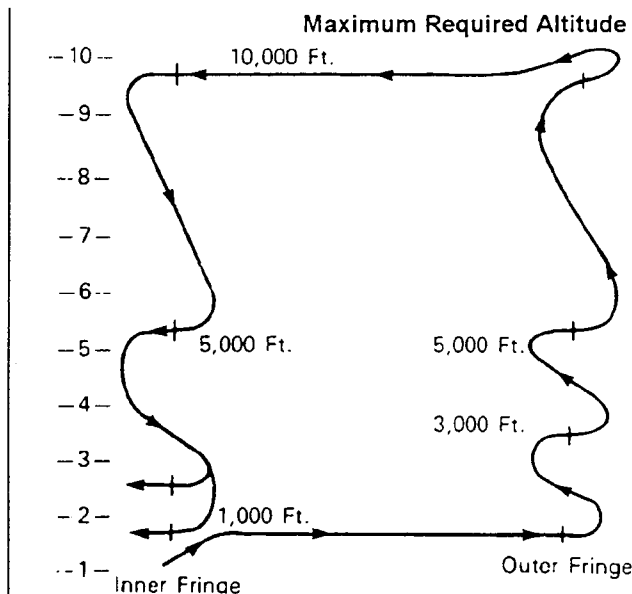
(b) Checks of additional facility equipment configurations and altitudes will be at the option of facilities maintenance personnel.

(5) ATCRBS Antenna Change. When replacing the antenna with the same type, all inspection requirements may be completed using targets-of-opportunity. When the antenna is replaced with a different type, checklist requirements shall be completed using a flight inspection aircraft as required by the Checklist.

(a) Terminal Radar. The profile for a primary radar antenna change is indicated in Figure 215-3.

Figure 215-3

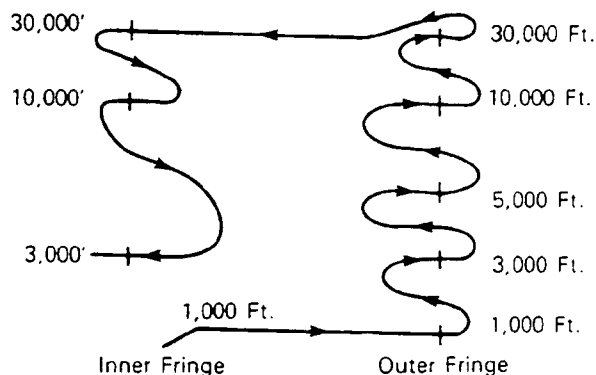
Antenna Change--ASR/ATCRBS



(b) **En Route Radar.** The profile for a primary radar antenna change is indicated in Figure 215-4.

Figure 215-4

Antenna Change--ARSR/ATCRBS



e. Evaluation. Facilities maintenance personnel shall record target strength as defined in paragraph 215.5a on each scan, aircraft position every five miles, and aircraft altitude for each fringe check and level run. Facilities maintenance personnel shall document results of the vertical coverage check using analysis/diagnostic

programs (RDAS tools), when available, for inclusion in the facility report.

215.3205 Horizontal Screening

a. Purpose. To verify the indicated coverage on the horizontal screening charts. This test is optional depending upon operational requirements and ground evaluation tools available. After reviewing the results of the vertical coverage check and other data, engineering personnel will determine if the horizontal coverage check is required.

b. Approved Procedure. Fly an orbit at an altitude and distance which corresponds to the lowest screening angle at which coverage is expected. Do not use an orbit radius of less than ten miles. AFIS, DME, or vectors provided by the controller may be used to maintain the orbit. MTI, if used, should be gated to a range inside the orbit radius, except where ground clutter obscures the targets unless MTI is used. If MTI is gated outside of the orbit, the radius of the orbit must be constantly changed to avoid target cancellation due to tangential blind speed. For example, vary the distance on a 12-mile orbit between 10 and 14 miles, flying oblique straight courses between the 10-mile and 14-mile orbits, so as to average a 12-mile orbital distance.

c. Evaluation. Facilities maintenance personnel shall record target strength, azimuth and distance every scan. They shall determine if the coverage supports operational requirements.

215.3206 Airway/Route Coverage

a. Purpose. To document coverage along routes and airways, required by AT. Facilities maintenance personnel shall determine the extent of these evaluations which determine the overall radar facility coverage. Areas of intense clutter, poor target returns, or other potential problems identified in the inspection plan may be further evaluated to determine actual facility coverage. This check shall be accomplished using targets-of-opportunity with the final commissioning check done with a flight inspection aircraft.

b. Approved Procedures.

(1) **Facilities maintenance personnel** shall configure the primary radar in "circular polarization". The altitudes at which satisfactory radar coverage exists will be determined by flying the minimum altitude (not lower than MOCA) on airway centerline. The terminal arrival and departure routes and other areas of interest identified in the inspection plan will be flown at MOCA. Maintain course guidance by reference to AFIS, ground checkpoints, NAVAID signals, or radar vectors. Coverage verification using linear polarization may be checked at the discretion of the test engineer or, if a joint use site, by the DOD agency.

(2) **Targets-of-Opportunity.** Targets may consist of one or an assortment of aircraft returns on a particular airway, route or terminal radial. Targets used must be mode-C equipped so altitude information can be obtained. Scoring may be accomplished by either RDAS tools or manually. RDAS may be used to evaluate the track information of a selected (beacon code) target.

c. Evaluation. Facilities maintenance personnel shall determine if the facility coverage meets operational requirements.

215.3207 Fix/Map Accuracy.

a. Purpose. To verify all airways, routes, fixes, and runway centerlines on the video map display. Replacement map overlays, video maps, or digitally-generated maps do not require a flight inspection if facilities maintenance personnel can determine, using targets-of-opportunity, that the new map is accurate.

b. Approved Procedure. The flight inspector shall fly the minimum altitude where satisfactory radar coverage exists using NAVAID guidance, ground checkpoints, or AFIS to identify the airway, route, or fix. The procedure is the same whether using a flight inspection aircraft or targets-of-opportunity; facilities maintenance personnel compare reported aircraft position relative to the airway, route, or fix with the video map presentation. Similarly, verify runway centerline to video map alignment by observing landing and departing aircraft.

c. Evaluation. Compute the distance between the airway, route or fix, and the aircraft position, and apply the appropriate tolerance.

215.3208 Fixed Target Identification.

a. Purpose. To identify prominent, primary broadband targets used for range and azimuth accuracy checks when they cannot be identified by other means. This check may be accomplished using targets-of-opportunity or flight inspection aircraft.

b. Approved Procedure. Facilities maintenance personnel will select identifiable features from a comparison of the ground clutter return and geographic maps (islands, mountain peaks, towers, etc.). They should direct the pilot to the PE return. If the pilot can identify and describe the ground target, and the target is a permanent feature, record the PE in the inspection report.

c. Evaluation. The pilot shall identify and record a description of the PE for inclusion in the inspection report.

215.3209 Surveillance Approaches.

a. Purpose. All ASR approaches must be checked for accuracy and coverage by a flight inspection aircraft during commissioning inspections or any time a new approach procedure is developed. Additionally, military ASR approaches must be checked on a periodic basis. Surveillance approaches shall be evaluated using surveillance type radar scopes. Conducting an ASR approach on a PAR display is not acceptable for flight inspection purposes. ASR approaches are not authorized using ATCRBS only, and the ATCRBS display should be offset.

(1) **Approach to a Runway.** The approach course shall coincide with the runway centerline extended and shall meet accuracy and coverage tolerances.

(2) **Approach to an Airport.** The approach course shall be aligned to the MAP as determined by procedures and facilities maintenance personnel. Helicopter-only final approach courses may be established to a MAP no farther than 2,600 feet from the center of the landing area.

b. Approved Procedure. The controller shall provide vectors for a 10-mile ASR final approach. The flight inspector shall fly at MVA until reaching the final approach segment. The final approach segment shall be flown 100 feet below all mandatory altitudes. The flight inspector shall evaluate the approach procedure, evaluate the aircraft position relative to the runway centerline extended/airport, and determine if a landing can be made without excessive maneuvering.

c. Evaluation. ASR approaches shall meet flight inspection tolerances or be canceled by appropriate NOTAM action. The cancellation of an ASR approach does not constitute a restriction on the radar facility. When MTI is required for an ASR approach, information shall be documented on the flight inspection report. The use of MTI does not constitute a facility restriction; however, ASR approaches which require MTI are NOT authorized when this feature is inoperative.

215.3210 Side-Lobe Suppression.

a. Purpose. To set transmitter power levels in the beacon SLS or ISLS antenna elements. The use of SLS/ISLS improves beacon performance, reducing or eliminating ring-around caused by the side lobes of the antenna pattern. ISLS also reduces false targets which are normally caused by close, vertical reflecting surfaces. This check may be accomplished using targets of opportunity or flight inspection aircraft.

b. Approved Procedure. Facilities maintenance personnel shall select azimuths to be checked in areas where side lobe problems have occurred in the past. Fly these radials at 1,000 feet above the radar site elevation to the coverage limits (normally line-of-sight). Facilities maintenance personnel shall adjust the SLS or ISLS power levels while observing beacon inner-range coverage. The power levels shall be adjusted for minimum ring-around and false target returns. After making final adjustments, ensure that inner range coverage is still satisfactory.

c. Evaluation. Facilities maintenance personnel shall evaluate SLS/ISLS performance.

215.3211 ATCRBS Modes and Codes

a. Purpose: To verify the proper decoding of ATCRBS reply pulses. Facilities maintenance personnel shall ensure that all modes and codes are verified by equipment test procedures before requesting flight inspection. Codes 7500, 7600, and 7700 should not be used due to the possibility of alarming other facilities.

b. Approved Procedure. Facilities maintenance personnel shall monitor the flight inspection aircraft transponder replies or targets-of-opportunity throughout the vertical coverage, airway, route, and terminal checks to verify correct altitude readout. During these tests, facilities maintenance personnel should request the flight inspection aircraft use different modes or codes to sample various modes and code trains. When targets-of-opportunity are used, ensure that the sample contains all modes interrogated and a sufficiently large sample of codes to ensure correct decoding of beacon replies.

c. Evaluation. Facilities maintenance personnel shall ensure the displayed transponder reading agrees with the aircraft transponder setting.

215.3212 ATCRBS Power Optimization

a. Purpose. To reduce over-interrogation, over-suppression, fruit, and false targets caused by reflections. Optimum ATCRBS power shall be the minimum ATCRBS power to meet operational requirements.

b. Approved Procedures. The aircraft shall be positioned to fly an arc in the vicinity of the vertical coverage radial or mutually agreed to reference radial at maximum distance. The aircraft altitude shall be 10,000 feet for ASR's and 30,000 feet for ARSR's, or as close to these altitudes as operational conditions allow. The beacon transmitter power shall be adjusted to the minimum value that produces a usable beacon reply or target. During this check, ensure that the aircraft transponder antenna is not shielded by aircraft. An ATCRBS power optimization shall be performed with a flight inspection aircraft following an increase in antenna tilt.

Vertical coverage as flown by a flight inspection aircraft or targets-of-opportunity shall be checked using the power level established in this paragraph. The beacon shall be commissioned at this power level, plus 1 dB.

c. Evaluation. Facilities maintenance personnel shall observe ATCRBS performance during the ATCRBS power optimization for a usable beacon reply.

NOTE: Although this test may be accomplished during the vertical coverage check, any changes made in beacon power, as a result of this test, will invalidate any portion of the flight inspection checked previously.

215.3213 ATCRBS GTC/STC Evaluation.

a. Purpose: To evaluate the ATCRBS GTC/STC setting. It shall be adjusted prior to the flight inspection and confirmed during the vertical and airway/route coverage checks. GTC/STC reduces the interrogator receiver gain, as the range to the station reduces, thereby reducing ring-around and false targets.

b. Approved Procedures.

(1) Facilities maintenance personnel shall observe the flight inspection aircraft target for ring-around, during the vertical coverage and airway/route coverage checks. Ring-around is an indication the GTC/STC is improperly adjusted.

(2) If false targets and/or ring-around persists, conduct a special target scoring check conducted solely for setting GTC/STC. This test requires a flight inspection aircraft configured in accordance with the Checklist in Paragraph 215.31. Position the aircraft on the vertical coverage radial or mutually agreed to reference radial, either inbound or outbound, at 10,000 feet AGL for ASR's and at 30,000 feet AGL for ARSR's or as close to these altitudes as operational conditions allow. Facilities maintenance personnel shall examine the received beacon signal during the entire radial (fringe to fringe). Correct GTC/STC setting is indicated by a fairly constant signal level over the entire radial.

(3) STC may be established during ground checks and evaluated with targets-of-opportunity by using RDAS tools or other software tools.

c. Evaluation. Facilities maintenance personnel shall observe the display for minimum false ATCRB's targets or ring-around.

215.3214 Communications. The purpose of this check is to evaluate VHF/UHF communications capability within the radar coverage area. The flight inspector shall check

communications in accordance with Section 211, concurrent with the radar inspection.

215.3215 Standby Equipment. The purpose of this check is to evaluate the performance of standby equipment, and may be accomplished during pre-inspection testing using targets-of-opportunity. If standby equipment is available but not working, the flight inspector must be notified (see paragraph 106.32). Some radar installations are engineered to meet reliability requirements by the use of redundant parallel units, instead of standby transmitters. Conduct flight inspection of these facilities while the system is operating in parallel. A separate check of each channel is not required. Some replacement radar units are collocated in the building with the primary radar and share the same waveguide and antenna during installation and checkout. In this case, the standby transmitter cannot be placed in operation without an extended facility shutdown. The pre-inspection testing of these systems shall thoroughly test all redundant and standby units to ensure they meet or exceed tolerances established on the flight inspected channel. A standby antenna (duplicate) may be installed at selected locations to provide continued radar service, in the event of antenna failure. The commissioning requirements for a standby antenna will be completed using the antenna change checklist.

215.3216 Standby Power. The purpose of this check is to evaluate radar performance on standby (engine generator) power and shall be conducted during pre-inspection testing. Results are satisfactory when the engine generator monitor equipment detects a power failure, starts the engine, and switches to the engine power without manual intervention. Conduct this test with a simulated power failure by manually switching out the incoming commercial power.

215.4 Analysis.

a. Testing Precautions. Radar inspections should not be attempted during heavy precipitation, temperature inversions, or other atmospheric conditions which change the coverage from normal. Whenever a system parameter does not meet tolerances and cannot be adjusted within a reasonable length of time, discontinue the flight inspection until the discrepancy is resolved. This does not preclude the continuation of tests in an effort to resolve the problems.

b. Evaluation. Usable radar coverage does not mean a usable target return on every scan at every azimuth and all usable altitudes. Missed targets can be caused by antenna lobing, line-of-sight, aircraft attitude, or antenna tilt. Therefore, isolated or non-recurring target misses are to be expected. If three or more consecutive misses are experienced, determine if a hole exists in the radiation pattern and determine its size. If holes or poor coverage are discovered, they must be evaluated to determine the effect on the operational requirements.

c. Probing. Holes in radar coverage are probed in a manner similar to VOR to TACAN. The following procedure may be used as a guide:

(1) Horizontal. Fly through the area of the suspected hole to determine the inner and outer boundaries. Vary the aircraft position every 10 degrees of radar azimuth until the lateral limits are established.

(2) Vertical. Fly through the center of the pattern established in the horizontal probing procedure at 1,000-foot increments to determine the upper and lower limits of the hole.

Figure 215.5

Tolerances

Parameter	Reference	Tolerance/Limit
Target Strengths		
Broadband/Reconstituted		
3—usable		Target leaves trail or persists from scan-to-scan without trail.
2—usable		Target shows each scan, remains on the display for at least 1/3 of the scan.
1—unusable		Weak target, barely visible, possible miss.
0—unusable		No visible target.
Narrowband		
1—usable		Visible target, satisfactory for ATC purposes.
0—unusable		No visible target, unsatisfactory for ATC.
Usable Target		Target which is not missed/ unusable on three or more consecutive scans.
Orientation	215.3201	$\pm 2^\circ$
Maximum azimuth difference between actual and indicated for broadband and narrowband radar systems.		
Tilt	215.3202	No airborne tolerance.

Parameter	Reference	Tolerance/Limit
Coverage		
Vertical from inner to outer fringe	215.3204	Meets operational requirements at all altitudes.
Horizontal	215.3205	No tolerance.
Approaches, airways, arrival and departure routes, and fixes route/procedure	215.3206	A usable target return shall be maintained along the entire route or throughout the procedure.
Accuracy		
Fix/map	215.3207	Within 3% of aircraft to antenna distance or 500' (1,000' for ATCRBS), whichever is greater.
Approaches	215.3209	
Straight-in		Within 500' of runway edge at MAP.
Circling		Within a radius of the MAP which is 3% of the aircraft to the antenna distance or 500', whichever is greater.
Altitude Readout	215.3211	± 125' of altitude displayed in the cockpit relative to 29.92 in Hg.
ATCRBS Power	215.3212	No tolerance
GTC/STC	215.3213	No tolerance
Communications	Section 211	See paragraph 211.5
Standby Equipment	215.3215	Meet same tolerances as main (dual channel) equipment. See paragraph 106.32.
Standby Power	215.3216	See paragraph 106.43

215.6 Documentation. The AF regional office of concern, or military equivalent, shall compile and complete the facility inspection performance report. It shall be a detailed accounting of all coverage data obtained using ground testing data, flight inspection aircraft, targets-of-opportunity, RDAS tools, and all flight inspection report information. The report submitted by the flight inspector shall contain only that information evaluated by the flight inspection crew. At joint use sites, the RADES shall publish a separate report for each joint evaluation.

215.7 Facility Classification. The facility inspection performance report shall reflect a facility classification determined by the facility engineer in charge (or military equivalent). The flight inspection report shall reflect a facility classification jointly determined by the flight inspector and facilities maintenance personnel. Inaccuracies beyond established tolerances in range and azimuth for fix/map targets or surveillance approaches, will be the basis for the flight inspector to restrict the system or to request that it be removed from service until the condition is corrected.

SECTION 216. PRECISION APPROACH RADAR (PAR)

216.1 INTRODUCTION

a. This section provides instructions and performance criteria for certifying precision approach radars. The PAR is designed to provide an approach path for precise alignment and descent guidance to an aircraft on final approach to a specific runway through interpretation and oral instructions of a ground based controller.

b. PAR's provide a very high degree of resolution in terms of range, azimuth and elevation by radiating a narrow pulse and beam width. The pulsed beams are radiated along the predetermined descent path for an approximate range of 10 to 20 miles, and covers a sector of 20° in azimuth and up to 15° in elevation. Target information is displayed on an azimuth and elevation display. The displays must provide accurate information regarding an aircraft's range, azimuth, and elevation angle.

c. New Generation PAR's have been developed which provide all of these features with the addition of a selectable glidepath angle and the introduction of a computer generated target.

216.2 PREFLIGHT REQUIREMENTS

216.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with the procedures outlined in Section 106.

216.22 Flight Personnel. The flight inspector will be in complete charge of the flight inspection. Flight personnel will prepare for the inspection in accordance with the procedure outlined in Section 106.

216.23 Special Equipment Requirements. Aircraft with altimeters calibrated according to FAR 43, appendix E, and FAR 91.170 or military specifications may be used for PAR flight checks. Theodolite or AFIS is required as follows:

a. During commissioning and/or after accident inspection of the glidepath angle and the lower safe angle.

b. Any time that more definitive analysis is required (e.g., engineering, research, development, etc.) of either the glidepath or the course azimuth.

216.24 Theodolite Procedures. The RTT or theodolite will be positioned as follows:

a. Glidepath Angle

(1) Place the theodolite as close to the runway as possible, forward of the RPI, to minimize or eliminate elevation differences between RPI (touchdown) and theodolite locations. The touchdown reflector is usually abeam the RPI, but not always. Therefore, the facility data sheet must be checked to establish the exact RPI location. Aircraft operations will dictate how close to the runway the theodolite can be located.

NOTE: During the commissioning inspection of a new or relocated PAR, it is imperative that flight inspection personnel coordinate closely with the TERPS specialist and installation personnel to locate the predetermined RPI.

(2) The distance the theodolite must be moved forward of the RPI to have the eye-piece aligned on the glidepath angle can be computed in the same manner as solving for ILS glidepath angles or tapeline altitudes. For example, a theodolite with the eye-piece set at 5 feet at a glidepath angle of 3.0° would be positioned 95.4 feet forward of the RPI.

b. Lower Safe Angle

(1) If the lower safe angle emanates from the same RPI as the glidepath, the theodolite position will be the position determined for the glidepath.

(2) If the lower safe angle emanates from a point other than the RPI for the glidepath, the theodolite will be relocated. Position and align the theodolite in accordance with instructions for glidepath angle using the lower safe angle RPI.

c. **Course Alignment.** Position the theodolite on runway centerline to evaluate course alignment at the runway threshold. Aircraft operations will dictate theodolite placement.

216.3 Flight Inspection Procedures. The flight inspection procedure for a PAR is divided into three parts:

a. Azimuth radar

b. Elevation radar

c. Overall system and controller performance (includes feature comparisons).

Commissioning inspections will provide engineering, maintenance, and operations personnel with sufficient data to determine system performance. Data obtained from the commissioning inspection will be the basis for the comparison of facility performance on subsequent inspections. Requirements for special checks will be determined by engineering, maintenance, and operations personnel, and will be conducted as specified in Section 104.

216.31 Checklist. This checklist is solely for clarity of presentation and does not indicate any required sequence of events. Frequently the flight inspector will be able to combine several of these checks and obtain the required information in a very short time. At locations where approaches to more than one runway are provided, checks will be accomplished for each runway on commissioning inspections. For periodics, checks will be accomplished in accordance with Section 105, assuring that all runways are checked at least once every 540 days.

Type Check	Reference Paragraph	C	P
a. Course Alignment (Azimuth)	216.3201	X	X
b. Course Deviation Accuracy	216.3202	X	X
c. Range Accuracy (Azimuth & Elevation)	216.3203	X	X
d. Coverage (Azimuth & Elevation)	216.3204	X	X
e. Coverage (Lateral)	216.32041	(1)	(1)
f. MTI (Azimuth & Elevation)	216.3205	X	(1)
g. Glidepath Alignment	216.3206	X	X
h. PAR/ILS Comparison	216.3207	X	X
i. Lower Safe Limit Alignment	216.3208	X	X
j. Approach Lights	216.3209	X	X
k. Communications	216.3210	X	X
l. Standby Equipment	216.3211	X	(2)
m. Standby Power	216.3212	X	(3)

NOTES:

- (1) Perform check when requested by engineering/maintenance.
- (2) See paragraph 106.42.
- (3) See paragraph 106.43.

216.311 Requirements for PAR Using Computer Generated Targets. PAR's which use a computer generated target, such as the GPN-22 and TPN-19, have some unique requirements. During the initial commissioning inspection or to commission new primary and/or backup data bases, the following procedures will be used.

Type Inspection

C	P	Data base Change	Run	Configuration
X	X	X	1	"A" cursor, primary data base using track mode-normal, acquisition (ACQ)-automatic, FTC-on, MTI-coherent.
X		X,1	2	"A" cursor, primary data base using track mode-backup, ACQ-off (scan only), FTC-off, MTI non-coherent.
X			3	"A" cursor, backup data base, using the same features as run 1.
X	X		4	"B" cursor, backup data base, using the same features as run 1.
X		X	5	"B" cursor, primary data base using the same features as run 1.

NOTES:

1. Each data base requires a flight inspection prior to operational use in order to verify that the data base data can be loaded into the PAR computer and that the data produces the correct results. For a data base change inspection, run 2 is required ONLY when the data base is of a different version. If the new data base is of the same version as the data base being replaced, then runs 1 and 4 (normal periodic requirements) shall suffice.
2. Establish coverage limits during commissioning (or at maintenance request) by flying a 20-mile final approach; thereafter, controller/maintenance personnel shall monitor coverage on a daily basis using targets of opportunity.
3. Evaluate the operation on standby power during any of runs 1, 3, 4, or 5.
4. If one reference reflector and a common glidepath angle are used for parallel runways, only five runs are required for commissioning two data bases. Fly runs 1, 2, and 3 on the left runway, runs 4 and 5 on the right runway (1, 4, and 5 on the right runway if reflectors and/or angles are different), and reverse the order for opposite end.

For a single runway operation, reverse the data base sequence on the opposite end approach; i.e., fly run 1 on the backup data base, etc.

5. Commissioning requirements for standby equipment (consisting of a complete separate channel) can be completed by flying runs 1, 2, and 5 to any one of the runways served. If standby equipment is only a separate transmitter, fly run 1 from 20 miles to satisfy commissioning requirements.

6. All other inspection requirements common to all PAR's also apply (see paragraph 216.31).

7. Document the following information for commissioning inspections and equipment/data base changes:

- a. Transmitter power.
- b. Receiver sensitivity in normal, coherent MTI, and non-coherent MTI.
- c. Data base type, part, serial, and version numbers.
- d. Clutter reject if required for approaches.
- e. Digital MTI base line limiting settings
- f. Usable radar range on 20-mile radar.

8. Due to system improvements, some features listed may not be available or controller selectable.

The following checklist shall be used to flight inspect AN/TPN-22 computer-generated PAR's.

C	P	Run	Configuration
X	X	1	"A" Cursor Auto-Mode (Note 1)
X		2	"B" Cursor Auto-Mode
X		3	"A" Cursor Manual-Mode (Note 2)
X	X	4	"B" Cursor Manual Mode

NOTES:

1. Controllers shall configure the Auto-Mode as follows: Load the PAR Program, OPS software, and System Initialization (SI) data and configure the Control and Status Panel per Table 1.

2. Controllers shall configure Manual-Mode as follows: Erase the OPS software and SI data, enter the basic SI data into the FC basic mode, and configure the Control and Status Panel per Table 1.

3. Standby power should be performed on the last run due to the extensive time required to reload the software and data.

4. All other inspection requirements common to all PARs also apply. See para 216.31.

5. Document the following information for commissioning inspections and hardware, software, or firmware changes.

- (a) Transmitter output power
- (b) Receiver sensitivity
- (c) Program name, part, version, serial number, and build date
- (d) Usable radar range

Sample program inventory sheet:

PROGRAM NAME	PART #	VERSIO N #	SERIA L #	BUILD DATE
PAR PROGRAM	N/A	V5R6	102	1/18/94
PAR PROGRAM	N/A	V5R6	103	1/18/94
CCS OPS SOFTWARE	111440	L-4	1000	7/25/94
CCS OPS SOFTWARE	111440	L-4	1001	7/25/94
CCS OPS SOFTWARE	111440	L-4	1002	7/25/94
CCS OPS SOFTWARE	111440	L-4	1003	7/25/94
CCS OPS SOFTWARE	111440	L-4	1004	7/25/94
CCS OPS SOFTWARE	111440	L-4	1005	7/25/94
CCS OPS SOFTWARE	111440	L-4	1006	7/25/94
CCS OPS SOFTWARE	111440	L-4	1007	7/25/94
CCS OPS SOFTWARE	111440	L-4	1008	7/25/94
CCS OPS SOFTWARE	111440	L-4	1009	7/25/94
PDS NVS FIRMWARE	111420	A-4	N/A	6/17/90
S.I. DATA	N/A	N/A	N/A	11/16/95
S.I. DATA	N/A	N/A	N/A	11/16/95

TABLE 1
Auto/Manual Mode Configuration

Button/Group	AUTO-MODE	MANUAL MODE
RCVR IF AMP		
AUTO	ON	ON
MANUAL	OFF	OFF
MTI GROUP		
MTI	ON	ON
7 DEGREE WEDGE	OFF	OFF
VELOCITY OFFSET	OFF	OFF
CFAR GROUP		
CFAR	ON	ON
AZIMUTH SECTOR GROUP		
20 DEGREE	OFF	OFF
30 DEGREE	OFF	OFF
46 DEGREE	ON	ON
ALS PAR MODES GROUP		
AUTO	ON	OFF
MANUAL	OFF	ON

216.32 Detailed Procedures

a. General. The basic method for checking a PAR is to have the controller vector the aircraft and provide guidance instructions to the flight inspector for evaluation of the facility.

b. Maintenance/engineering personnel in cooperation with operations personnel will spot check all features available on the PAR and advise the flight inspector if any of these features are not available or are unusable. These features include STC, FTC, and CP. On computer-generated radars, additional features include: non-coherent MTI (rain reject), ACQ (high and low), track mode (normal and backup), STC (high and low), and power (high and low). PAR checks will be made using circular polarization (CP) if available, and spot checks of the facility will be made using linear polarization. On some computer generated radars, CP is a fixed feature and is used at all times.

c. Operational scopes will be used on all flight checks for target grading and guidance information. Data taken from the operational scopes shall determine whether or not the facility meets the prescribed tolerances.

d. Suitability and approval of approach procedures previously developed by the procedures specialist are based on the flight check of the particular facility.

216.3201 Course Alignment (Azimuth). Any of the following methods may be used:

a. Visual Method. To check for course alignment, proceed in-bound at pattern/intercept altitude from approximately 10 to 12 miles from the runway and, when on-course and path, descend at a normal glidepath angle with the final controller furnishing information to enable the flight inspector to fly on the centerline azimuth. This information is to be given as "left," "right," or "on-course." Range should be given at least every mile. The flight inspector will determine, by visual reference to the runway, if the centerline is straight and if it coincides with the runway centerline extended.

b. Theodolite Method. At some locations, it may be necessary to use a theodolite to supplement the pilot's observations, especially when the runway is extremely wide or poorly defined by surrounding terrain. Proceed in-bound at pattern/intercept altitude from 10 to 12 miles from the field. Have the final controller furnish information as to the aircraft's position relative to runway centerline. The theodolite operator will continuously track the aircraft and inform the pilot of the aircraft position relative to runway centerline.

216.3202 Course Deviation Accuracy. While flying inbound on runway centerline extended, deviations to the right or left of centerline should be made with attention directed as to how far the aircraft must move off centerline before the controller notices movement. The controller needs only to state - slightly left (or right) of centerline.

216.3203 Range Accuracy. Check the accuracy of the range information, both video and fixed, by comparing the range information obtained from the radar scope with that obtained from a large scale map while over selected checkpoints or by comparison with DME. Checkpoints such as the outer marker or VOR are excellent; however, any well surveyed checkpoint is satisfactory, provided its distance from the field can be established. All ranges are measured in nautical miles from touchdown. In areas where there are no ground checkpoints or good electronic means of accurately measuring distance from the field, such as DME, this check may be omitted. Normally, two checkpoints, one at from 5 to 10 miles and one at 1/2 mile, are sufficient for checking range accuracy. Range accuracy checks of azimuth and elevation radar normally will be made simultaneously. (See paragraph 216.3204, Note.)

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SECTION 217. INSTRUMENT LANDING SYSTEM (ILS)

217.1 INTRODUCTION. This section provides instructions and performance criteria for certifying localizer and glidepath which operate in the VHF and UHF band. Flight inspection of the associated facilities used as integral parts of the instrument landing system shall be accomplished in accordance with instructions and criteria contained in their respective sections of this manual or in other appropriate documents.

a. **The two basic types of localizers** are single frequency and dual frequency. Localizers are normally sited along the centerline of the runway; however, some are offset from the centerline. Localizer type directional aids (LDA) may be located at various positions about the runway.

b. **Another type of facility which provides azimuth guidance** is the simplified directional facility (SDF). The two basic types of SDF facilities are the null reference type and the phase reference type.

c. **The three basic image array glide slope systems** are null reference, sideband reference, and capture effect. The two non-image array systems are the endfire and the waveguide.

d. **Flight inspection techniques** using the FAA automated flight inspection system (AFIS) are detailed in other directives. Where AFIS is available, these techniques shall be used to accomplish the approved procedures in this section.

217.11 ILS Zones and Points. ILS zones and points are defined in Section 301 and are illustrated in Figure 217-1.

217.2 PREFLIGHT REQUIREMENTS

217.21 Facilities Maintenance Personnel. Prepare for flight inspection in accordance with paragraph 106.31.

217.22 Flight Personnel. Prepare for flight inspection in accordance with paragraph 106.32.

217.23 Special Equipment Requirements. RTT or AFIS is required as follows:

a. Glide Slope

(1) **Category (CAT) I.** On site, commissioning, after accident, and categorization inspections, and for confirmation of out-of-tolerance conditions.

(2) **CAT II and III.** For all inspections to determine structure and angle.

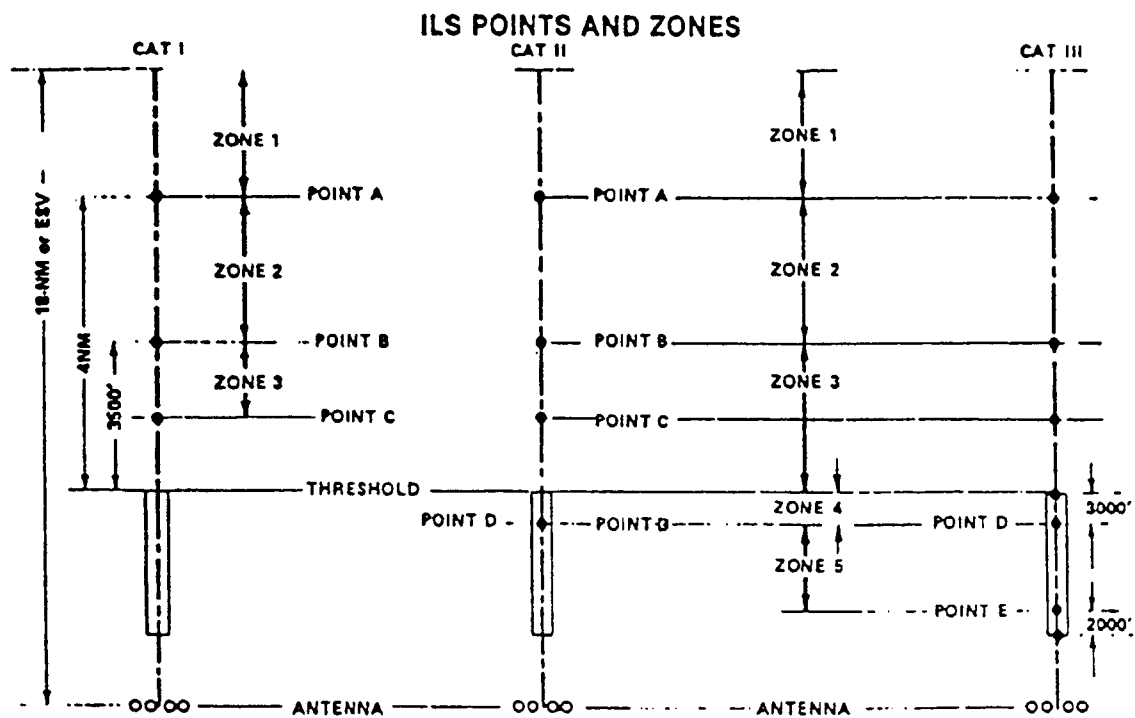
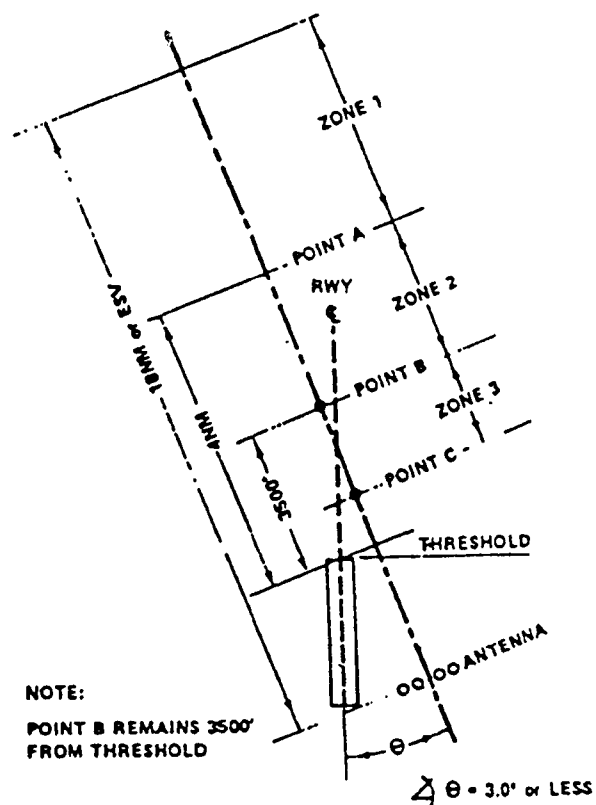
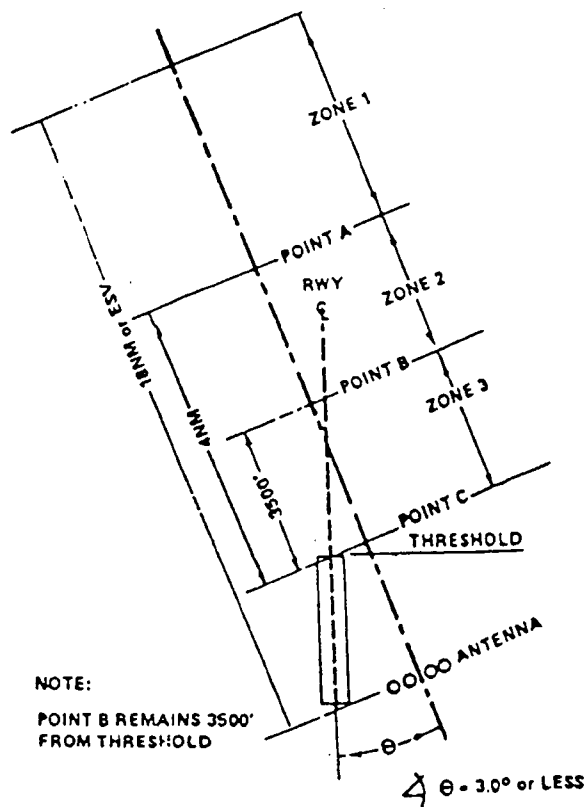
b. **Localizer.** To confirm marginal or out-of-tolerance conditions.

c. **RTT or AFIS** shall be used at any time that more definitive alignment and structure analysis are required (e.g., engineering requirements, research and development, etc.). RTT is used to obtain actual facility performance when AFIS is not available.

217.231 When RTT or AFIS equipment is not available, a standard theodolite may be used except during glide slope category determination inspection or for the measurement of actual glidepath angles during commissioning checks.

217.24 Glidepath Origination Point. The glidepath origination point is required for AFIS-equipped aircraft. For image array glide slopes, engineering personnel shall supply the latitude/longitude of the antenna mast and the mean sea level elevation of the glidepath origination point. For non-image arrays, engineering personnel shall supply the latitude, longitude, and mean sea level altitude of the glidepath origination point.

Figure 217-1A

**TYPICAL OFFSET ILS****TYPICAL OFFSET LOCALIZER**

(2) The theodolite shall be positioned using the data in paragraph c(1) corrected for eyepiece height.

d. Localizer. The use of a theodolite, AFIS, or RTT is not required for any inspection on a localizer sited along runway centerline, regardless of category, providing performance can be satisfactorily evaluated by flying a visual centerline track.

The position of the theodolite, when used during localizer evaluations, will be placed on a line perpendicular to the localizer antenna array aligned so as to sight along the reciprocal of the calculated true course and at a point as close to the center of the array as possible.

e. Aircraft Tracking

(1) **Glide Slope.** The optimum tracking point on the flight inspection aircraft is the glide slope antenna.

(2) **Localizer.** The optimum tracking point on the flight inspection aircraft is the localizer antenna.

217.3 FLIGHT INSPECTION PROCEDURES

217.31 Checklist

a. ILS Site Evaluations. Site evaluations if performed, are made prior to installation of permanent equipment. The need for a site evaluation, and additional requirements, shall be determined by engineering personnel on the basis of individual site conditions.

b. Periodic Checks. A periodic check without monitors shall consist of an inspection of the localizer and glide slope transmitter that is on the air, plus the operating transmitter of the supporting NAVAIDs. If out-of-tolerance conditions are found, inspect the standby equipment, if available.

c. Periodic with Monitors. Consists of a periodic performed on both primary and standby equipment, plus the operating transmitter of the supporting NAVAIDs. Facilities that have dual parallel monitors require a monitor evaluation on one transmitter only. Facilities that have two individual monitors require monitor evaluations on each transmitter.

d. Frequency Change. Following a localizer (SDF, LDA) or ILS frequency change, conduct a special inspection that fulfills the following requirements: Periodic with monitors (Pm), RF power alarm monitor, and spectrum analysis.

e. Other Component Changes. See paragraph 104.5.

217.3101 Facility Checklists by Type. Flight inspection requirements are contained in the following checklists and in the discussion paragraphs in this section. The checklists are provided as a guide and do not necessarily indicate a sequence of checks. Consult the text to ensure a complete inspection.

Legend:

Fc = Localizer front course.

Bc = Localizer back course.

A = After accident inspection.

C = Commissioning or commissioning type equipment.

E = Site evaluation.

Pm = Periodic inspection with monitors.

P = Periodic inspection without monitors.

a. Single Frequency Localizer, LDAs and SDFs.

NOTE: Bc checks do not apply to uni-directional antennas.

REMARKS:

(1) Maintenance request.

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with facilities maintenance personnel.

(4) Applicable to phase reference SDFs only.

(5) Facilities with dual transmitters and single solid state modulators—check both transmitters.

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required					
		E	C	Pm	P		MOD STRUC	WIDTH	SYM	CLR	ALIGN	
Spectrum Analysis	217.3201	Reserved										
Ident. & Voice	217.3214	(1)	X	X	X							Fc&Bc
Modulation Level	217.3202	X	X	X	X	Normal	Fc					
Modulation Equality (2)	217.3202 217.3203	(1)	(1)			Carrier Only						
Phasing (3)	217.3205	(1)	(1)			Quadrature	Set to Value of Modulation Equality					
Width & Clearance	217.3206 217.3210	X	X	X	X	Normal		Fc&Bc	Fc&Bc	Fc&Bc		
Alignment and Structure	217.3207	X	X	X	X	Normal	Fc				Fc&Bc	Fc&Bc
Polarization (One XMTR Only)	217.3213	X	X	X	X	Normal						Fc&Bc
Monitors (5) Width	217.3208	(1)	X	X		Wide Alarm		Fc&Bc		Fc&Bc		
		(1)	X			Narrow Alarm		Fc		Fc(4)		
		(1)	X			Alignment Alarms					Fc	
RF Power Monitor Reference	217.3209	(1)	X			Reduced RF Power				Fc&Bc		Fc&Bc
High Angle Clearance (One XMTR Only)	217.32101	X	X			Normal				Fc&Bc		
Standby Equipment	217.3401 106.42		X	X								
Standby Power	217.3402 106.43		X			Normal	Fc&Bc	Fc&Bc	Fc&Bc		Fc&Bc	

b. Dual Frequency Localizer.

REMARKS:

(1) Maintenance request.

(2) Adjustments to carrier modulation balance will require a subsequent check of course alignment.

(3) Width and clearance should be measured prior to the phasing check. If, after the quadrature phase check, the width has remained the same or has narrowed and/or the clearances have increased from the first width and clearance check, then the phasing has been improved. Final determination of optimum phase should be discussed with facilities maintenance personnel.

Type Check	Ref. Para.	Inspection				Transmitter Configuration		Measurements Required					
		E	C	Pm	P	Course XMTR	Clearance XMTR	MOD STRUC	WIDTH	SYM	CLR	ALIGN	
Spectrum Analysis	217.3201	Reserved											
Ident. & Voice	217.3214	(1)	X	x	x								Fc&Bc
Power Ratio	217.3204	(1)	X			RF Alarm	Normal						
Modulation Level	217.3202	X	X			Normal	OFF	Fc					
		X	X			OFF	Normal	Fc					
		X	X	X	X	Normal	Normal	Fc					
Modulation Equality (2)	217.3202 217.3203	(1)	(1)			Carrier Only	OFF	Fc	Balance Determined by Maintenance				
		(1)	(1)			OFF	Carrier Only	Fc	Balance Determined by Maintenance				
Phasing (3)	217.3205	(1)	(1)			Quad	OFF		Set to Value of Modulation Equality				
		(1)	(1)			OFF	Quad		Set to Value of Modulation Equality				
Width & Clearance	217.3206 217.3210	(1)	(1)			OFF	Normal		Fc				
		X	X	X	X	Normal	Normal		Fc&Bc	Fc&Bc	Fc&Bc		
Alignment and Structure	217.3207	X	X	X	X	Normal	Normal	Fc&Bc				Fc&Bc	Fc&Bc
Polarization One XMTR Only)	217.3213	X	X	X	X	Normal	Normal						Fc&Bc

b. Dual Frequency Localizer.—Continued

Type Check	Ref. Para.	Inspection				Transmitter Configuration		Measurements Required					
		E	C	Pm	P	Course XMTR	Clearance XMTR	MOD	WIDTH	SYM	CLR	ALIGN	STRUC
Monitors Width	217.3208		X			Wide Alarm	Normal		Fc				
		(1)	X			Narrow Alarm	Wide Alarm		Fc&Bc		Fc&Bo		
		(1)	X	X		Wide Alarm	Wide Alarm		Fc&Bc		Fc&Bc		
Dephase			(1)			ADV Phase	Normal		Fc				
			(1)			RET Phase	Normal		Fc				
			(1)			Normal	ADV Phase		Fc		Fc		
			(1)			Normal	RET Phase		Fc		Fc		
Alignment			X			Normal Alarms	Align-ment						
			X			Align-Normal ment Alarms						Fc	
RF Power Monitor Reference	217.3209	(1)	X			Reduced RF Power Alarm	Reduced RF Power Alarm				Fc&Bc		Fc&Bc
High Angle Clearance (One XMTR Only)	217.32101	X	X			Normal	Normal				Fc&Bc		
Standby Equipment	217.3401 106.42		X	X									
Standby Power	217.3402 106.43		X			Normal	Normal	Fc&Bc	Fc&Bc	Fc&Bc		Fc&Bc	

f. Waveguide Glide Slope with Auxiliary Waveguide Antennas.—Continued

Type Check	Ref. Para.	Inspection				Facility Configuration	Measurements Required							
		E	C	Pm	P		STRUC BELOW CLEAR- ANCE STRUC							
							MOD	WIDTH	ANGLE	SYM	PATH	ANCE	STRUC	
Monitors Width	217.3313	(1)	X	X		Wide Alarm		X	X		X(2)	(3)		
			X			Narrow Alarm		X	X		X(2)			
			X	X		Main Sideband: ADV Phase		X	X		X(2)	(3)		
		X	X		RET Phase		X	X		X(2)	(3)			
One XMTR Only			X X X			Upper Auxiliary Waveguide: Attenuate ADV Phase RET Phase		X X X	X(4) X(4) X(4)			X X X	X X X	
		One XMTR Only		X		Lower Auxiliary Waveguide: Attenuate		X	X(4)			X	X	
				One XMTR Only	X X		Upper & Lower Waveguide Simultaneously: ADV Phase RET Phase		X X	X X		X(2) X(2)		X X
One XMTR Only				X X	X X		Main Waveguide Feed Phaser: ADV Phase (4) RET Phase (4)		X X	X X		X(2) X(2)	(3) (3)	
Angle One XMTR Only				X			Lower Main Waveguide Feed: Attenuate (High Angle)		X	X		X(2)		
One XMTR Only				X			Upper Main Waveguide Feed: Attenuate (Low Angle)		X	X		X(2)	(3)	
RF Power Monitor Reference		217.3314	(1)	X			Reduced RF Power							
Standby Equipment		217.3401 106.42		X	X									
Standby Power		217.3402 106.43		X			Normal	X	X	X	X	X(2)		

g. Endfire Glide Slope Standard (capture effect in the horizontal plane.)

CODE: W/A/S = Width, Angle, Symmetry

REMARKS:

(1) Maintenance request.

(2) If structure below path tolerances cannot be met, clearance procedures and techniques will be applied.

(3) Required on commissioning type inspections.

(4) On facilities without a phase monitor, conduct dephase check on the width monitor with main sideband dephasing of ± 15 degrees or less.

Type Check	Ref. Para.	Inspection				Facility Configuration		Measurements Required						
								STRUC						
		E	C	Pm	P	Primary XMTR	Clear XMTR	MOD	WIDTH	ANGLE	SYM	BELOW PATH	CLEAR-ANCE	STRUC
Spectrum Analysis	217.3301	Reserved				Reserved								
Engineering Support Tests	217.3305	(1)	(1)			As Required								
Modulation Level	217.3302	X	X	X	X	Norm	Norm	X						
Modulation Equality	217.3303	(1)	(1)			Carrier Only	OFF	X						
W/A/S	217.3306	X	X	X	X	Norm	Norm		X	X	X	X(2)		
Structure	217.3310	X	X	X	X	Norm	Norm	X						
Clearance	217.3307	X	X			Norm	Norm						X	
Transverse Structure	217.3311	X	X	(1)		Norm	Norm							X
Tilt (One XMTR Only)	217.3309	X	X			Norm	Norm	X		X			X	
Mean Width	217.3308	(1)	X			Norm	Norm		X		X			
Transverse Structure	217.3311	(1)	X	(1)	(1)	Norm	Reduced RF Power							X
Clearance at 5° Each Side of LCZR Course	217.3307	(1)	X			Norm	Reduced RF Power						X	
Clearance at 8° Each Side of LCZR Course	217.3307	(1)	X			Norm	Reduced RF Power						X	
Spurious Radiation	217.33053	(1)	(1)			Dummy Load	Dummy Load							X

g. Endfire Glide Slope—Standard (capture effect in the horizontal plane)—Continued.

Type Check	Ref. Para.	Inspection				Facility Configuration		Measurements Required						
						Primary XMTR	Clear XMTR	STRUC						
		E	C	Pm	P			MOD	WIDTH	ANGLE	SYM	BELOW PATH	CLEAR- ANCE	STRUC
Monitors Width	217.3313	(1)	X	X		Wide Alarm	Norm		X	X		X(2)	(3)	
Phase		(1)	X	X		ADV Phase (4)	Norm		X	X		X(2)	(3)	
		(1)	X	X		RTD Phase (4)	Norm		X	X		X(2)	(3)	
		(1)	X			Narrow Alarm	Norm		X	X		X(2)		
Angle		(1)	X	(1)		Main Array: Dephase for High Angle	Norm		X	X		X(2)		
		(1)	X	X		Main Array: Dephase for Low Angle	Norm		X	X		X(2)	(3)	
RF Power Monitor Reference	217.3314	(1)	X			Reduced RF Power	Reduce d RF Power							
Transverse Structure	217.3311		(1)			Norm	ADV CLR ANT Phase							X
			(1)			Norm	RET CLR ANT Phase							X
Standby Equipment	217.3401 106.42		X	X										
Standby Power	217.3402 106.43		X					X	X	X	X	X(2)		

217.3102 General Checklist. During a specific inspection, check the following items:

	A	E	C	Pm	P
75 Mhz Marker Beacons	X	-	X	X	X
Compass Locator	X	-	X	X	X
DME	X	-	X	X	X
Lighting Systems	X	-	X	X	X
Terminal En Route	X	(1)	X	(1)	(1)

Procedures (See Section 214)

(1) As required by ground technical or flight inspection personnel.

217.32 Detailed Procedures - Localizers. Unless otherwise noted, the following procedures apply to all localizers, offset localizers, LDAs, and SDFs.

217.3201 Spectrum Analysis. Reserved.

217.3202 Modulation Level. This check measures the modulation of the radiated signal.

a. Approved Procedure--Front Course. Measure modulation while inbound on the localizer, between 10 miles and 3 miles from the localizer antenna, and on glidepath (at LCA for localizer-only facilities). Preliminary checks may be made when transitioning the "on-course" position during course width and symmetry measurements; however, they must be validated while flying inbound on-course.

b. Approved Procedure--Back Course. Measure modulation by using the flight procedures described in a. above. On single frequency localizers, adjustments to front course modulation will also affect the back course; therefore, adjustments are not required on the back course. Where a separate antenna provides clearance, as well as a back course (such as the waveguide system), modulation checks and adjustments of the clearance transmitter(s) are valid only while on the back course, unless the course transmitter is OFF.

217.3203 Modulation Equality. This check is performed to obtain a crosspointer value which will be used as a reference for phasing.

Approved Procedure. Position the aircraft as outlined in paragraph 217.3202, Modulation Level. Adjustments to modulation equality will require a subsequent check of course alignment.

217.3204 Power Ratio Check. The purpose of this check is to measure the ratio of power between the course and clearance transmitters of dual frequency localizers.

Approved Procedure. This check is made with the course transmitter in RF Power alarm. A 10dB or greater differential is required with the transmitters in normal as measured by flight inspection.

(1) When using the spectrum analyzer, position the aircraft on the localizer on-course within 10 miles and in line-of-sight of the antenna or parked on the runway on-course in line-of-sight of the antenna. Compare the relative signal strength of the course and clearance transmitters with the course transmitter in RF power alarm and the clearance transmitter in normal.

(2) If a spectrum analyzer is not available, position the aircraft on the runway centerline/on-course at or near the approach end of the runway in line-of-site of the antenna. Use the AGC meter or equivalent and note the voltage level of the facility in the following configurations:

(a) Course transmitter in RF alarm; clearance transmitter OFF.

(b) Clearance transmitter in normal; course transmitter OFF.

Compute the power ratio using the dual frequency power ratio formula (see Section 302).

217.3205 Phasing. The purpose of this check is to determine that the phase relationship between the sideband and carrier energy is optimum. The facility will normally be phased using ground procedures. No specific requirement exists for airborne phasing.

a. Approved Procedure--Front Course. Since antennas vary greatly, obtain the correct azimuth for phasing the facility from facility maintenance personnel. Fly inbound toward the antenna on the appropriate azimuth at LCA between 10 and 3 miles. Transmit the crosspointer values to assist the ground technician to adjust the phasing. The optimum quadrature phase condition is established when the microampere deflection is the same as that found when checking modulation equality.

b. Approved Procedure--Back Course. If maintenance requests phasing on the back course, apply the procedures described in a. above.

217.3206 Course Sector Width and Symmetry. The purpose of this check is to establish and maintain a course sector width and ratio between half-course sectors that will provide the desired displacement sensitivity required at the procedural missed approach point (MAP) or threshold and be within the limitations of the procedural protected area.

a. Width Requirements. Localizers, offset localizers, and LDA's shall be tailored to a course sector width not greater than 6° and a linear sector width of 700 feet at the following points:

(1) Point C for LDA and SDF

(2) Point B for runways less than 4000 feet long and for runways which do not conform to precision instrument design standards.

(3) Point T for facilities supporting all other applications.

The tailoring requirement may be waived for facilities supporting other than CAT II or III operations if tailoring cannot be achieved due to siting constraints, performance derogation, etc.; however, the final width shall be established as close as possible to the optimum. The justification shall be included in the flight inspection report. If the course sector width on a facility which supports a precision approach will not provide for at least 400 feet linear width at the runway threshold, the course shall be restricted as unusable inside the point where the linear width is less than 400 feet. The commissioned course width of an SDF shall be no greater than 12.0° . If the course width is adjustable, it shall be tailored. USAF CAT I localizers with antenna to threshold distance which would cause the tailored width to be less than 3° will be commissioned at 3° . Facilities previously commissioned at less than 3° need not be widened only to meet the 3° requirement.

b. Approved Procedure. This procedure applies to the front course (and back course if it is used for an approach or missed approach). Measure the course sector width and symmetry between 4 and 14 miles from the localizer antenna at the LCA, providing the modulation levels are in tolerance. Higher altitudes up to ESV may be used, provided that a comparability check in the normal configuration was made (usually at commissioning) at the LCA and the higher altitude, and the results were within tolerance and were within $\pm 0.2^\circ$ (if the higher altitude is used, it shall be documented on the data sheet). Subsequent inspections may be made at LCA, the higher altitude, or any altitude between.

(1) Basic Method. A crossing, perpendicular to the on-course, shall be made in each direction, maintaining a constant airspeed (to average out any wind component) over a checkpoint of a known distance from the localizer antenna, i.e., outer marker, FAF, etc. If ground speed or along-track outputs are available, only one crossing is required. Measure the course sector width and calculate the symmetry (use the appropriate formulas in Section 302).

(2) Theodolite or Tracking Device Method. Position the theodolite or tracking device in accordance with paragraph 217.25, Theodolite Procedures. Only one crossing is

required; maintain a constant airspeed. Reference the course sector width to the azimuth reference marks of the theodolite (usually spaced 5° apart). Measure the course sector width, using a device such as 10 point dividers, and calculate the symmetry.

NOTE: An RTT may be used to track an aircraft throughout the course sector. Apply the course sector width received to the calibration of the RTT.

217.3207 Course Alignment and Structure. These checks measure the quality and alignment of the on-course signal. The alignment and structure checks are usually performed simultaneously; therefore, use the same procedures to check alignment and structure.

a. Approved Procedure. This procedure applies to the front course (and the back course) if it is used for an approach or missed approach).

(1) General. Evaluate the course along the designed procedural azimuth from the furthest point required by the type of inspection being conducted throughout the remaining zones. Maintain the published or proposed procedural altitudes through each approach segment until intercepting the glidepath and then descend on the glidepath to Point C or runway threshold.

(a) For a localizer-only approach, the published or proposed procedural altitudes shall be maintained in each segment, except the final segment shall be flown as follows: Upon reaching the FAF inbound, descend at a rate of approximately 400 feet per mile (930 feet per minute at 140 knots; 800 feet per minute at 120 knots) to an altitude of 100 feet below the lowest published MDA and maintain this altitude to Point C, which is the MAP. **NOTE:** See Section 301 definition of Point C for localizer only approaches.

(b) For ILS approaches which support localizer-only minima, the procedure specified in (a) above shall be used in addition to the run on normal glidepath during the following inspections: Site, Commissioning, and Specials for antenna system change, user complaint or site modifications, and on a periodic inspection any time there is a significant deterioration of localizer structure.

(c) For localizers which are aligned along the runway centerline, the aircraft may be positioned along the runway centerline by visual cues, or theodolite. When RTT or AFIS equipment is used, the localizer on-course signal shall be flown. For localizers which are not aligned along the runway centerline, theodolite, RTT, or AFIS are the preferred methods of evaluation. For localizers oriented toward a non-descript point in space, where adequate visual checkpoints are not available to validate actual course alignment, the alignment may be determined to be either Satisfactory (S), or Unsatisfactory (U) in lieu of course alignment values (refer to paragraph 214.32011). The initial monitor evaluation shall establish an equality of modulation reference for subsequent alignment and monitor comparison.

(2) Procedures for CAT II and III ILS.

(a) Site, Commissioning, Reconfiguration and Categorization Inspections. Use the procedures in paragraph a(1) until reaching point C. Cross point C at 100 feet, runway threshold at approximately 50 feet, and continue on the extended glidepath angle to the touchdown point. Continue the landing roll and determine the actual course alignment for ILS zones 4 and 5. Measure the course structure from the actual alignment. If the actual alignment for zones 4 and 5 cannot be determined using this method, taxi the aircraft along the runway centerline from the runway threshold to point E. Record the raw crosspointer information and mark the threshold, point D and point E. Manually calculate the actual course alignment and structure for each of the required zones.

(b) Periodic or Special Inspections which require Structure Analysis. Use the procedures in paragraph a(1) until reaching point C. Cross point C at 100 feet, runway threshold at 50 feet, and then conduct a low approach at 50 to 100 feet, on runway centerline, throughout the required zones. If the aircraft cannot be maintained on centerline for evaluation of zones 4 and 5 due to wind conditions, the evaluation may be conducted by taxiing the aircraft down centerline throughout zones 4 and 5.

NOTE: If structure appears to have deteriorated since the previous inspection, or if out-of-tolerance structure is found, verify the results of this check by flying the procedure listed in a(2)(a) above.

b. Zones to be inspected for structure. The inspection of localizer zones vary, depending upon the ILS category and/or the type of inspection that is being performed (see Section 301 and Figure 217-1 for zone definition).

Type Approach/ Facility	Zones to be Inspected
Category III	Zones 1, 2, 3, 4, 5
Category II ILS	Zones 1, 2, 3, and 4 (see paragraph 107.34)
Category I ILS	Zones 1, 2, 3
Other types of facilities or approaches	Zones 1, 2, 3 from average alignment

NOTE: During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change inspection—check all of zone 1.

All other inspections (i.e., periodic, periodic with monitors, etc.) evaluate structure from GSI or the FAF (whichever is further) through all other required zones.

After Accident Inspections. See paragraph 104.51.

Category II localizers failing to meet structure tolerance in zone 4 will not be shown as restricted on the flight inspection report; however, a NOTAM will be issued. See paragraph 107.34.

c. **Alignment Areas.** Determine the course alignment in the following areas:

Front Course	From	To
CAT I, II, III	One mile from runway threshold	Runway threshold
ILS Zone 4	Runway threshold	Point D
ILS Zone 5	Point D	Point E
Offset Localizers	One mile from runway threshold	Runway threshold or abeam runway threshold
LDAs and SDFs	One mile from Point C	Point C
Back Course		
All Types of Facilities	Two miles from the antenna	One mile from the antenna

NOTE: When a restriction occurs in an area where alignment is normally analyzed, measure alignment by manually analyzing the average course signal in the following areas:

From	To
One mile from the start of the restriction.	The start of the restriction.

217.32071 Glide Slope Signal on Localizer Back Course. Evaluation of localizer back course approaches shall also include an evaluation for active glide slope signals. Glide slope signals that result in flag or CDI activity shall be cause for immediate action to alert pilots to disregard all glidepath indications on the back course approach (i.e., NOTAM). Ensure the alert will be printed on the localizer back course instrument approach chart.

217.3208 Monitor References. The inspector shall ensure that the facility is set at the monitor reference prior to each check. Monitor references shall be checked IAW paragraph 217.31c when prescribed by the checklist and when applicable on special inspections.

a. Alignment Reference. This check is performed to assure that the monitors will detect a specific shift of the localizer course.

(1) **Approved Procedure—Front Course.** It is not necessary to verify ground alignment monitor checks in the air or to verify airborne alignment monitor checks on the ground.

Request the course be misaligned to the monitor alarm limits each side (90 Hz/150 Hz) of the operational course. Both the recorder and the visual display shall be used to verify course alignment shifts. During any inspection, the monitor limits shall be referenced to the designed on-course alignment according to facility category.

(a) **Ground.** After the airborne localizer alignment has been determined, position the aircraft near the runway threshold where the stable crosspointer is received. The aircraft may be displaced as much as 75 μ A from the on-course signal. (This option is authorized, providing the sensitivity of the course sector width is linear.) The received course indication shall be referenced to the alignment found airborne. Request that maintenance shift the course to both of the monitor limit points and then return to normal.

At facilities that are installed offset to the runway, the alignment monitor limits may be established with the aircraft on the ground within 75 μ A of the on-course signal; but the aircraft shall not be positioned closer than 3,000 feet from the antenna array. If these two conditions cannot be met, perform this check in the air (see (b) below).

If facility alignment is adjusted on the ground before the monitor inspection and a misalignment is found during the airborne evaluation, a recheck is not required if the following criteria are met during the ground adjustment:

1 In-tolerance flag/modulation and AGC exist.

2 Crosspointer is stable.

3 Crosspointer data are recorded as found during adjustment and at the final setting.

4 All data are clearly labeled to reflect the adjustment(s) made.

(b) **Airborne.** Perform airborne alignment monitor checks while inbound on the designed procedural azimuth (on localizers aligned along runway centerline, the aircraft should be aligned with the centerline extended). Measure the alignment shifts to monitor limits by recording the instantaneous course displacements or course shifts as referenced to runway centerline extended. If feasible, this may be accomplished on one run during which both limit points and a return to normal are recorded.

(c) **Equality of Modulation.** When course alignment is satisfactory and a monitor inspection is required, localizers may be evaluated for monitor references using equality of modulation method. This method may be used on all categories of localizers with the concurrence of maintenance personnel. All facilities shall be flown to establish the alignment in a normal operating configuration. Once the alignment has been established, maintenance will set up an equality of modulation configuration. The equality used to establish the alignment will become the reference for the subsequent monitor readings. When requested, maintenance personnel will unbalance the modulation to achieve the monitor reference point. Measure the displacement in microamps, repeat the procedure in the other direction, then restore to normal. This may be accomplished in the air or on the ground and need not be performed on centerline. Use of this method will be noted in the remarks section of the flight inspection report.

(2) **Approved Procedure—Back Course.** This check may be accomplished on the back course using the procedures described in paragraph (b) above, or on the front course, as in paragraph (a) or (b) without the waveguide transmitter radiating.

b. Width Reference - Approved Procedure. Use the flight procedure and methods described in paragraph 217.3206.

217.3209 RF Power Monitor Reference. This inspection is conducted to determine that the localizer meets specified tolerances throughout the service volume while operating at reduced power.

a. Approved Procedure. This procedure applies to the front course (and the back course if it is used for an approach or missed approach).

This check shall be conducted with the facility operating at reduced power. Check for interference, signal strength, clearances, flag alarm current, identification, and structure as follows:

Steps:

(1) Fly an arc across the localizer course at 18 miles from the antenna (or ESV distance, whichever is greater), at 4,500 feet above site elevation (or ESV altitude, whichever is higher) throughout Sector 1.

(2) Repeat step one except fly across the localizer at the LCA.

(3) Proceed on course, inbound from 18 miles (or ESV, whichever is greater) maintaining the LCA to 10 miles.

(4) Fly an arc across the localizer course at 10 miles from the antenna at the LCA throughout sectors 1 and 2 (and 3, if procedurally required).

(5) Maintain the LCA and proceed in-bound on course until reaching 7 degrees above the horizontal (measured from the localizer antenna) or point C, whichever occurs last.

217.3210 Clearance. Clearances are measured to ensure that the facility provides adequate off-course indications throughout the service volume (or ESV, whichever is greater).

a. Approved Procedure. This check applies to the front course (and the back course if it is used for an approach or missed approach). The clearance orbit will be conducted at a radius between 5 to 10 miles from the antenna at the LCA. After commissioning, higher altitudes may be used, provided a comparability check is made (usually at commissioning) at the LCA and the higher altitude. The results at the higher altitude must be the same or more restrictive (e.g., clearances lower). This comparison shall be documented on the data sheet. Clearances shall be rechecked at the LCA following any modifications or adjustments to the localizer (wide alarm) or when environmental changes occur.

(1) Check Sectors 1 and 2. Check Sector 3 if it is required to support a transition. Check only that portion of the arc in Sector 3 on the side of the course which contains the transition.

(2) A course used exclusively for missed approach guidance and/or a fix shall meet clearance tolerances in Sector 1.

(3) Use event marks to accurately identify the 10 degree, 35 degree, and when necessary, the 90 degree azimuth from the published localizer azimuth to assist in interpreting and orienting the recording. If the results of an orbit/arc indicate less than minimum clearance, adjustments shall be made to correct the low clearance condition. When adjustments are made, recheck course width, modulation, and alignment.

b. Inspections.

(1) **Monitor Reference Evaluations.** Check clearances in the monitor limit configurations described in the appropriate checklist. It is not necessary to check clearances in the normal configuration if the clearances found during the monitor checks are equal to or greater than the tolerances required for normal.

(2) **Commissioning.** Check clearances in both the normal and the monitor limit configurations described in the appropriate checklist.

217.32101 High Angle Clearance. This check determines that the transmitted signals provide proper off-course indications at the upper limit of the service volume. Conduct this check during a site evaluation, commissioning inspection, or when a change in location, height, or type of antenna is made.

Approved Procedure. This check applies to the front course (and the back course if it is used for an approach or missed approach). This check is only required on one transmitter.

- a. **Fly a 10-mile arc through Sectors 1 and 2** (and 3, if procedurally required), at 4,500 feet above the antenna (or ESV, whichever is greater).
- b. **If clearances are out-of-tolerance**, additional checks will be made at decreasing altitudes to determine the highest altitude at which the facility may be used.

217.3211 Coverage. Coverage shall be evaluated concurrently with each required check during all inspections.

217.3212 Reporting Fixes, Transition Areas, SIDs, STARs, and Profile Descents. Refer to **Figure 217-2**. The localizer, SDF, or LDA may be used to support fixes, or departure, en route, and arrival procedures. Transitions may be published through air space which are beyond the localizer, SDF, or LDA service volume. Under these circumstances, navigation is accomplished by using some other facility such as VOR or an NDB. Facility performance of all facilities involved shall be checked to ensure that all coverage parameters are within tolerance. This shall be done during a commissioning inspection, when new procedures are developed or redescribed, or on appropriate special inspections (e.g., user complaints).

Approved Procedure. This check applies to the front course (and the back course if it is procedurally used). The facilities (Localizer and/or Glide slope) shall be checked in RF power alarm.

- (1) Fixes. If the localizer is used for a cross course fix indication, it shall satisfy coverage tolerances in Sector 1 on both sides of the localizer on-course. In addition, check the on-course signal throughout the fix displacement area. Conduct these checks at the minimum authorized altitude.

EVALUATE COVERAGE

LOC (A) B1 to B2
VOR (B) A1 to B2 ($R \pm 4.5^\circ$)
VOR (B) A3 to B4

- (2) Transitions. When a transition (or missed approach routing) is designed to traverse localizer course Sector 3 or air space which is outside the commissioned service volume and the transition termination point is not identified with a facility other than the localizer course

(e.g., compass locator, lead radial, etc.), check clearance and coverage throughout the entire transition air space at the minimum authorized altitudes. This will normally be an approach segment from a facility or fix to intercept a localizer final approach.

EVALUATE COVERAGE

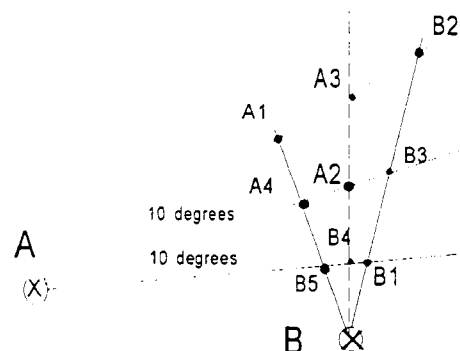
LOC (A) B to A2

VOR (B) B to A2

- (3) SID's. Check on-course structure throughout the area of intended use. Check clearance in Sector 1 at the termination point at the minimum authorized altitude.

- (4) STARS and Profile Descents. Fly these procedures as proposed or as published. Check facility performance when checking STARS and profile descents in accordance with paragraphs (1) and (2) above, with fixes.

Figure 217-2



- 217.3213 Polarization Effect.** The purpose of this check is to determine the effects that vertical polarization may have on the course structure.

Approved Procedure. This check applies to the front course (and the back course if it is procedurally used), and may be accomplished concurrently with the course structure check. This check is only required on one transmitter.

Fly inbound on-course at a distance between 12 and 6 miles from the facility and roll the aircraft to a 20-degree bank left and right. Actuate the event mark at the maximum banked attitude.

- 217.3214 Identification and Voice.** This check is made to ensure identification and voice (if installed) are received throughout the

coverage area of the localizer. See paragraph 217.3211.

SDFs have a three-letter coded identifier. Localizers and LDAs have a three-letter coded identifier preceded by the code letter I.

Approved Procedure. This procedure is applicable to the front course (and the back course if it is procedurally used).

Record the identification during all checks. Check voice transmissions when on-course, at the LCA, and at the maximum distance at which course structure is being evaluated.

A localizer shall be restricted if identification cannot be received in all areas of required coverage.

A localizer shall not be restricted solely because the voice/ATIS cannot be received. In this event, advise the procedures specialist and/or air traffic operations personnel.

217.33 Detailed Procedures—Glide Slope.

217.3301 Spectrum Analysis. Reserved.

217.3302 Modulation Level. This check measures the modulation of the radiated signal.

Approved Procedure. Measure the modulation of the glidepath while inbound on the localizer/ glidepath course between 7 and 3 miles from the glide slope antenna with a signal strength of 150 μ V or greater.

217.3303 Modulation Equality. This check establishes the balance of the carrier signals. This check should be made prior to any phasing checks and will be used as the reference for phasing.

Approved Procedure. Have maintenance personnel configure the facility to radiate carrier signal only. When checking capture effect facilities, the primary transmitter radiates this configuration while the clearance transmitter is off or in dummy load.

Use the procedure described in paragraph 217.3302, Modulation Level. While descending, call out the balance to facilities maintenance personnel. Zero μ A is optimum. An imbalance in excess of 5 μ A shall be adjusted towards optimum.

217.3304 Phasing. This check determines that the correct carrier and sideband-only phase relationship are distributed to the antennas.

a. Approved Procedure. Phasing may be performed on the ground (by maintenance) or in the air. Consult the appropriate checklist in paragraph 217.3101. Proceed inbound 8-10 miles from the glide slope antenna along the localizer on-course, preferably at 1,000 feet above glide slope site elevation. Altitude may vary with terrain to provide line of sight. The flight inspection technician should relay the microammeter indications to the facilities maintenance personnel.

Maintain the level run and have maintenance adjust the phaser until the crosspointer is the value found during the modulation equality check. Upon reaching a point 1/3 to 1/2 of the glidepath angle, commence a descent. Maintain this angular descent until reaching runway threshold. Do not make facility adjustments inside 4 miles during the angular descent. Record crosspointer throughout the phasing run.

(1) **Analysis of Phasing Results.** Analyze the crosspointer trace during the descent portion of the maneuver. Make additional phasing adjustments as needed until the average crosspointer during the descent portion average the same value found during the modulation equality check.

If the microammeter value varies from the average during the descent between 1/2 mile from the threshold and runway threshold, the antenna offset may be incorrect and should be checked (antenna offset is most accurately established and set by maintenance).

(2) **Maintenance Coordination.** A comparison of airborne and ground phasing data should be made by maintenance personnel in order to determine if optimum phasing has been established.

b. Null Reference Phasing Make the following checks and phase the facility in the configurations listed below:

Sidebands Radiating in Quadrature to Carrier. Perform the maneuver described in paragraph 217.3304a, Phasing.

c. Sideband Reference Phasing. Make the following checks and phase the facility in the configuration listed below:

(1) Upper Antenna Feed in Dummy Load. Have facilities maintenance personnel insert a 90-degree section in the main sideband line. Conduct a level run at 1,000 feet above site elevation between 10 to 5 miles from the glide slope antenna. Adjust the phaser to the value found during the modulation equality check.

When phasing is completed, remove the 90-degree section and check for fully fly-down signal. This indicates that the lower antenna sensing is correct. If full fly-up signal is indicated, sensing is incorrect and the facility must be adjusted.

(2) Radiate Upper and Lower Antennas with a 90-degree Section in the Main Sideband Phaser. Use the procedure described in paragraph 217.3304a, Phasing. Have maintenance adjust the upper antenna phaser to the value found during the

modulation equality check. When this value is attained, remove the 90-degree section from the main sideband line. Ensure that a fly-up signal is received when the aircraft is below the glidepath.

d. Capture Effect. Capture effect glide slopes are normally phased on the ground by maintenance personnel; however, they may request airborne phasing. The airborne phase verification procedure shall be accomplished when requested by maintenance. This procedure confirms that correct phasing has been achieved.

(1) Airborne Phase Verification Procedure. This procedure helps maintenance to determine if proper phasing exists. Both transmitters may be checked if standby equipment is installed.

Airborne Phase Verification Procedures

PARAMETER							
Steps	Checks	Modulation	Width	Angle	Symmetry	Structure Below Path	Path Structure
(a)	Modulation	X					
b)	Modulation Equality	X					
(c)	Normal Configuration	X	(1)	(2)	X	X	(6a) X
(d)	Main Sideband Phaser Dephased Advance*		(3)	(4)		X	
	Retard*		(3)	(4)		X	
(e)	Middle Antenna Phaser Dephased Advance*		(3)	(5)		X	(6b)
	Retard*		(3)	(5)		X	(6b)
(f)	Normal	X	X	X		X	

FOOTNOTES:

- (1) Adjust glidepath width to $0.70^\circ \pm 0.03^\circ$.
- (2) Facility shall be adjusted to within 0.05° of commissioned angle for commissioning type inspections.
- (3) Width— 0.1° sharper or 0.2° wider than normal.
- (4) Angle— $\pm 0.1^\circ$.
- (5) Angle— $\pm .05^\circ$.
- (6) Clearance—At a fixed angle of 1.0° from 4 miles to runway threshold.
If obstruction clearance is a limiting factor, an acceptable higher fixed angle may be used.
 - (a) 180 μ A or better.
 - (b) 150 μ A or better

Footnotes (3), (4), (5), and (6) are not tolerances; they are results which are expected.

* Actual degrees advance or retard to be determined by maintenance.

(2) Airborne Phasing. When airborne phasing is requested, use the procedure described in paragraph 217.3304d(2)(a) or (b) below, or other alternate procedures specified by maintenance. Facilities maintenance personnel shall determine which procedure is to be used.

(a) Airborne Phasing Procedure No.1. Confirm that maintenance has established normal carrier sideband ratios and that ground phasing is complete.

NOTE: The clearance transmitter is de-energized throughout steps (1)-(4).

Airborne Phasing Procedure No. 1

Steps	Type Check	Reference Paragraph	Configuration	Unit of Interest
(1)	Modulation Level	217.3302a	Carrier Only	In Tolerance
(2)	Modulation Equality	217.3303a	Carrier Only	Crosspointer $0\mu A \pm 5\mu A$
(3)	Phasing	217.3304a	Upper to Middle Antenna Lower Antenna—Dummy Load Middle Antenna—Radiate Carrier + Sidebands Upper Antenna—Radiate Sidebands Main Sideband Phaser—Quadrature	Crosspointer centered about the value found in step (2).
(4)	Phasing	217.3304a	Lower to Upper and Middle Antenna Lower Antenna—Radiate Carrier + Sidebands Middle Antenna—Radiate Carrier + Sidebands Upper Antenna—Radiate Sidebands Main Sideband Phaser—Quadrature	Same as above.
(5)	Phase Verification	217.3304d(1) Steps (c)-(f)		

(b) Airborne Phasing Procedure No. 2. This procedure only applies to those facilities in which it is possible to separate carrier and sideband signals in the APCU (Amplitude and Phase Control Unit). Confirm that facilities

maintenance personnel have established normal carrier sideband ratios and that ground phasing is complete.

NOTE: The clearance transmitter is de-energized throughout steps (1)-(4).

Airborne Phasing Procedure No. 2

Steps	Type Check	Ref. Para.	Configuration	Unit of Interest
(1)	Modulation Level	217.3302a	Carrier Only	In Tolerance
(2)	Modulation Equality	217.3303a	Carrier Only	Crosspointer $0\mu A \pm 5\mu A$
(3)	Phasing	217.3304a (See note a below)	Lower to Middle Antenna Phasing Lower Antenna - Radiate Carrier Only Middle Antenna - Radiate Sidebands Only Upper Antenna - Dummy Load Main Sideband Phaser - Quadrature	Crosspointer Centered about the value found in step (2)
(4)	Phasing	217.3304a (see note b below)	Lower to Upper Antenna Phasing Lower Antenna - Radiate Carrier Only Middle Antenna - Dummy Load Upper Antenna - Radiate Sidebands Only Main Sideband Phase - Quadrature	Crosspointer Centered about the value found in step (2)
(5)	Phase Verification	217.3304d(1) Step (c) - (f)		

NOTE: a) Step (3) phasing runs should be accomplished at an elevation angle of 1/2 the glidepath angle (or up to 2/3 of the angle if terrain prevents the lower angle.)

b) Step (4) Phasing runs should be accomplished at an elevation angle equal to the glidepath angle.

If the level run symmetry is not acceptable, the AFIS, RTT, or theodolite shall be used to determine the mean symmetry (see paragraph 217.3308, Mean Width). Apply the mean symmetry as a correction factor to level runs; annotate on AMIS. If the symmetry still remains out-of-tolerance, the facility shall be removed from service.

d. Structure-Below-Path. This check determines that the 190uA/150Hz point occurs at an angle above the horizontal which is at least 30 percent of the commissioned angle. The structure below path is determined from the data obtained during the level run angle or width measurements. Altitudes lower than GSI may be required to make this measurement.

NOTE: The structure-below-path point does not have to occur within the service volume of the facility to be a valid check, provided the AGC and flag alarm current indications are within appropriate tolerances.

If the 190uA/150Hz point, in any facility configuration, cannot be found, conduct a clearance below path check starting at the edge of the service volume. Apply the appropriate tolerance.

217.3307 Clearance. This check is performed to assure that positive fly-up indications exist between the bottom of the glidepath sector and obstructions. Clearances above the path are checked to ensure that positive fly-down indication is received prior to intercepting the first false path.

a. Approved Procedure.

(1) Clearance Below the Path. Fly along the localizer on-course (or the areas specified by the checklist). Check that the required amount of fly-up signal (180uA in normal, 150uA in any alarm condition) provides adequate obstacle clearance between the FAF or GSI, whichever is further, and:

CAT I - ILS point "C" for an unrestricted glide slope; or the point at which the glide slope is restricted.

CAT II and III - Runway threshold.

(2) Clearance Above the Path. Check that 150uA fly-down occurs prior to the first false path. Perform this check during the level runs in accordance with the approved procedure, paragraph 217.3306a(1).

217.3308 Mean Width. This check, performed during site evaluation, commissioning, and reconfiguration inspections, is used to determine the mean width of a glidepath between ILS Points "A" and "B". This check may also be used to determine the mean symmetry of the glidepath. Theodolite, RTT, or AFIS shall be used. The path width should be established, as nearly as possible, to 0.7° prior to the check.

Approved Procedure. Fly inbound on the localizer on-course maintaining 75uA above the glidepath between ILS Point "A" and "B". Repeat the same run at 75uA below the glidepath, and again while on the glidepath.

Determine the mean width from the angle found above and below the glidepath and calculate symmetry from the on-path angle.

217.3309 Tilt. This check verifies that the glidepath angle and clearances are within the authorized tolerance at the extremities of the localizer course sector. Apply the actual angle correction factor to the level run angles in the Tilt check.

Approved Procedure. With the glide slope facility in normal, measure clearances below the path at each extremity of the localizer course sector from the GSI to point B. In addition, measure the path angle and clearance above the path on each side of the localizer course at the GSI using the level run method. This check is only required on one transmitter.

217.3310 Structure and Zone 3 Angle Alignment. These checks measure structure deviations and zone 3 angle alignment. Measurements are made while the facility is operating in a normal configuration, except for special structure evaluations on waveguide facilities.

a. Approved Procedure. Fly inbound on the glidepath and localizer course from 10 miles from the glide slope antenna or glide slope ESV (whichever is greater) through all zones. The structure shall be evaluated in all zones and the category (CAT) II and III angle alignments in zone 3. Angle alignment shall be evaluated using the RTT or AFIS.

b. Inspections.

(1) During site, commissioning, reconfiguration, categorization, antenna, and/or frequency change, evaluate the structure by using the entire procedure described in paragraph a above.

(2) During all other inspections (i.e., periodic, periodic with monitors, etc.) this evaluation can be accomplished from the GSI or FAF (whichever is further) by using the procedure described in paragraph a above.

217.3311 Transverse Structure--Endfire Glide Slope. This is a measurement of the horizontal structure of the glidepath at the FAF distance, between 8° each side of the localizer on-course.

a. Approved Procedure. Fly an arc at a radius equal to the distance from the localizer antenna to the FAF, but no less than 5.0 miles from the glide slope antenna, at the FAF altitude corrected to true altitude. Record both localizer and glide slope crosspointers: Localizer crosspointer Cal 400uA and glide slope crosspointer Cal 400. For engineering support, use localizer crosspointer Cal 400 uA and glide slope crosspointer Cal 150 uA. The arc may be flown either clockwise or counter-clockwise.

b. Analysis. No tolerance is applied to transverse structure, but the following results are expected. Results exceeding the expected values will require engineering analysis prior to final resolution.

(1) **Within the localizer course sector,** the change of the glide slope signal should not exceed plus or minus 48uA from the crosspointer value found on the localizer on-course.

(2) **From the edge of the localizer course sector to 8° from the localizer on-course,** signals should not exist that are greater than 48uA in the 90 Hz direction from the glide slope crosspointer value found on the localizer on-course.

217.3312 Coverage. Coverage shall be evaluated concurrently with each required check during all inspections.

217.3313 Monitors. The purpose of these checks is to measure glidepath parameters when the facility is set at the monitor reference. The inspector shall ensure that the facility is set at the monitor reference prior to each check. Monitor references shall be checked IAW paragraph 217.31c when prescribed by the checklist, and when applicable on special inspections.

At the conclusion of any monitor inspection, the facility shall be returned to normal, and the following checks performed and results reported: Angle, Width, Symmetry, and Structure Below the Path, 217.3306.

a. Approved Procedure. Use the level run method (paragraph 217.3306a(1)) to measure width, angle, and structure below the path in the monitor limit conditions. Check clearances in accordance with 217.3307.

b. Inspections--Periodic with Monitors. There is no requirement to check the facility in normal prior to conducting the monitor check.

217.3314 RF Power Monitor Reference. This check is conducted to determine that the glide slope meets specified tolerances throughout its service volume while operating at reduced power.

a. Approved Procedure. The glidepath transmitter shall be placed in reduced power setting for this check (both primary and clearance transmitters for capture effect and endfire glide slopes). This check shall be made on the localizer on-course and 8° on each side of the localizer on-course.

While maintaining the LCA, fly inbound from 10 miles from the facility, or ESV (whichever is further), to the interception of the lower sector of the glidepath (i.e., the point nearest the glidepath at which 150 uA occurs). Fly through the glidepath sector and check clearances above the path.

The endfire glide slope antenna array is orientated toward the runway. The normal fly-up/fly-down signal ends at approximately 5° on the antenna side of the runway; therefore, you will have only 150 Hz clearance signal at 8° on the antenna side of the runway. The provisions of paragraph 217.44 will apply to this situation.

In situations where the GSI intersects the glidepath at a distance that provides less than 150uA fly-up signal, descend to an altitude which will provide at least 150 uA fly-up while providing adequate obstacle clearance at 10 miles or ESV (whichever is further).

217.34 General.

217.3401 Standby Equipment - Localizer/Glide Slope. Where dual equipment is installed, complete all checklist items for both sets of equipment, except as noted in the text of this section, and the checklists.

217.3402. Standby Power - Localizer/Glide Slope. Refer to paragraph 106.43; if the check is required, make the following checks while operating on standby power.

a. Localizer. Course width, alignment, symmetry, modulation, and identification.

b. Glide Slope. Modulation, width, angle, symmetry, and structure below the path.

217.3403 Expanded Service Volume (ESV). Where an operational requirement exists to use either or both the glide slope and localizer to altitudes and/or distances beyond the normal service volume, the facility(ies) shall be inspected to the expanded altitudes and/or distances (in accordance with 217.3209 and 217.3314) to determine that facility performance for the required parameters meets tolerances. Place particular emphasis on signal strength, interference, clearances, and structure.

If a localizer or glide slope cannot support ESV requirements, the ESV shall be denied. The facility shall not be classified as restricted solely because it fails to support the ESV.

217.35 Supporting NAVAID's. These may consist of marker beacons, a compass locator, DME, and/or lighting systems. Additionally, some locations may require other types of NAVAID's to support the approach procedures.

217.36 Instrument Flight Procedures. See Section 214.

217.4 Analysis. A detailed analysis of the measurements and calculations made during the

course of the flight inspection provides an overall picture and permanent record of facility performance.

217.41 Application of Localizer/Course/Glide-path Structure Tolerances. Application of course structure analysis contained in this paragraph applies to all zones (1, 2, 3) of glidepaths and all zones of localizers (1, 2, 3, 4, & 5) and SDF's, including back courses. This application does not apply to site, commissioning, or categorization inspections. Refer to Figure 217-3. If course or path tolerances are exceeded, analyze the course/path structure as follows:

a. Where course/path structure is out-of-tolerance in any region of the approach, the flight recordings will be analyzed in distance intervals of 7,089 feet (1.17 nm) centered about the region where the out-of-tolerance or aggregate of out-of-tolerance condition(s) occurs. Two 7,089 foot areas will not overlap.

b. Where necessary to avoid overlap, centering the interval about the out-of-tolerance region may be disregarded.

c. It is not permissible to extend the 7,089 foot segment beyond the area checked, i.e., service volume or ESV, whichever is greater, or the point closest to the runway where analyzation stops.

d. The course/path structure is acceptable if the aggregate structure is out of tolerance for a distance equal to or less than 354 feet within each 7,089 foot segment.

NOTE: This application shall not apply to site or commissioning inspections.

217.42 Rate of Change/Reversal in the Slope of the Glidepath. The following analysis of the path angle recording shall be accomplished during all inspections where AFIS, RTT, or other tracking devices are being used. It applies to all categories of ILS.

a. Inspect the glidepath corrected error trace/differential trace in zones 2 and 3 for changes and/or reversals in the trend of the slope of the path trace.

b. **Determine if the trace** (or trend), on either or both sides of the point where a change in direction occurs, extends for at least 1,500 feet along the approach with an essentially continuous slope (see Figure 217-4).

c. **If one or more changes/reversals** meets the condition in b. above, draw a straight line through the average slope that covers at least a 1,500 foot segment each side of the point of change. It is permissible to extend the straight line of the average slope to inside Point C if required, in order to obtain the 1,500 foot segment. Determine the change-in-slope by measuring the divergence of the two lines at a point 1,000 feet from their intersection.

d. **NOTAM Action.** Facilities which do not meet this tolerance shall be restricted by a NOTAM that withholds authorization for autopilot coupled approaches below an altitude (MSL) which is 50 feet higher on the glidepath than the altitude at which the out-of-tolerance condition occurs. Compute the MSL altitude for such a restriction based on the commissioned angle of the facility. Advise the appropriate procedures specialist.

(1) **Category II and III** facilities are required to meet the established change/reversal criteria for that portion of the glidepath which is between the published GSI and Point C. The facility shall be classified as restricted if a change/reversal is found.

(2) **Category I** facilities should meet this change/reversal criteria. Category I facilities which do not meet this tolerance shall not be classified "restricted" if a change/reversal is found; however, NOTAM action shall be taken (see paragraph 107.24).

217.43 Application of Localizer Coverage Requirements. The maneuvering areas described in the approved procedures of this section define the standard service volume in which coverage tolerances shall be maintained in order for a localizer to be assigned a facility classification of "UNRESTRICTED". The localizer may still be usable when coverage does not meet tolerances throughout the standard service volume, depending on the effect of the restriction on procedural use. In evaluating such effects, all coverage criteria must be considered; however, for an UNRESTRICTED classification, the following criteria must also be met:

a. Clearances

(1) **Tolerance Application.** Deviations in any sector to less than 100 μ A are not acceptable. In Sectors 2 and 3, momentary deflections of the crosspointer to less than the tolerances are acceptable, provided that the aggregate area does not exceed 3° of arc in Sectors 2 and 3 combined in one quadrant. Such an area is acceptable on both sides of the localizer. Additionally, all the above criteria are applicable to the back course.

NOTE: One quadrant is defined as that area between the localizer on-course and a point 90° to the antenna.

(2) **Restrictions.** If a localizer is restricted in Sector 2, it shall not be used for a procedure turn on the restricted side, unless the inbound procedure turn course guidance is provided by some other facility, such as a VOR, NDB, etc.

(3) Momentary deviations of the Localizer cross pointer in Sector 1 can be averaged without further evaluation, provided the cross pointer deviation does not present a noticeable effect on flyability or create a possible false course. Questionable reversals of trend or excessive irregular flattening of the course ("steps") require an evaluation of the effect on the procedure. When this condition occurs, refly the sector 1 arc on one transmitter at the service volume limit at LCA at a maximum ground speed of 170 knots. Evaluate for noticeable effects on flyability and possible false course indications. The procedure shall be removed if reversals of trend exceed 10 μ A or flyable false course indications occur. If the arc at LCA is satisfactory for flyability, document the check on the facility data sheet, e.g., "Deviations in sector 1 clearance linearity evaluated on the front course/back course (as appropriate) and the results found satisfactory IAW 8200.1A, paragraph 217.43; Date mm/dd/yr."

b. Distance Requirements.

(1) Restrictions to localizer coverage at distances less than the standard service volume are permitted, provided the localizer meet all coverage tolerances throughout all procedural approach segments and at the maximum distance at which the procedure turn may be completed.

(2) Restrictions above the LCA are acceptable, provided a step-down fix, etc., can be added to the appropriate approach segment which restricts descent to within the altitude/distance at which acceptable coverage at the LCA was achieved.

c. Vertical Angle Requirements.

(1) If in-tolerance coverage cannot be maintained up to 7° or point C as required by step 5 in the RF power monitor check, the localizer may still be used for CAT I and nonprecision operations on a restricted basis; however, the localizer shall be classified as "unusable" if in-tolerance coverage cannot be maintained up to 4° or 1° greater than the commissioned glidepath angle, whichever is greater (both measured from the localizer).

(2) If vertical angle coverage is limited but the localizer can be used on a restricted basis as outlined above, a NOTAM shall be issued which restricts the localizer as "unusable" above a specified altitude, both at the threshold and at least one other point, usually the FAF (see example in Section 107). Note the angle at which unsatisfactory coverage occurred and evaluate its effect on the nonprecision MDA, maximum holding altitudes, and missed approach instructions/ protected areas.

217.44 Application of Glide Slope Coverage Requirements. The RF Power Monitor check described in paragraph 217.3314 defines the lateral and longitudinal standard service volume of the glide slope. Although there is no specified tolerance, the approved procedure specifies to check for clearances above the path. If there is no defined glidepath or clearance above path, the glide slope shall be restricted as unusable beyond the point at which no glidepath or clearance above path is provided. See an example in Section 107. The glide slope shall meet the tilt tolerance and the RF power monitor tolerance.

217.45 ILS Maintenance Alert. Facilities serving the National Airspace System (NAS) and U.S. Air Force facilities not serving the NAS shall be provided an ILS maintenance alert as follows:

a. An ILS maintenance alert shall be provided by flight inspection following a normal periodic check without monitors when a measured flight inspection parameter exceeds 60 percent of the flight inspection tolerance. This applies to the following critical monitored parameters:

- (1) Localizer course widths
- (2) Localizer alignment
- (3) Glide slope path widths
- (4) Glide slope angles

b. The flight inspector shall forward the ILS maintenance alert results by FAX or telephone (when FAX is unavailable) to the central scheduling and dispatch facility. The central scheduling and dispatch facility shall enter the results on FAA Form 8240-7-1, Appendix 11, FAA Order 8240.36 (current version) and forward the results by FAX or telephone (when FAX is unavailable) to the regional maintenance engineering branch within 24 hours. For U.S. Air Force facilities, notify the appropriate Major Command (MAJCOM) headquarters. When the results are forwarded by telephone, enter the name of the person contacted in the remarks block on FAA Form 8240-7-1, which shall be forwarded to the regional maintenance engineering branch.

c. When a measured flight inspection parameter exceeds the flight inspection tolerance, if AF maintenance is available and on site, request an evaluation of the parameter that has exceeded tolerance and determine whether it can be corrected. If the parameter that exceeded tolerance is corrected, leave the facility in service. If not, remove the facility from service and issue a NOTAM.

217.46 Glide Slope Snow NOTAM. During periods of heavy snow accumulation, Airway Facilities personnel may NOTAM glide slope facilities as "due to snow on the XXX (appropriate identifier), glide slope minima temporarily raised to localizer only." Category II/III operations are not authorized during the snow NOTAM. The following guidance is to be followed when an ILS is scheduled for a periodic inspection when a snow NOTAM is in effect and the flight inspection window is exceeded. Localizer flight checks shall be conducted as normally scheduled. Glide slope flight checks shall be accomplished dependent upon the following conditions:

a. If the NOTAM indicates localizer only for all categories of aircraft, then an approach evaluation shall be made to determine angle and structure. All out-of-tolerance conditions shall be reported to maintenance. After the snow NOTAM is canceled, flight inspection of the glide slope will be in accordance with paragraph 105.2. Enter "PI" in Block 22, Type of Check, on FAA Form 4040-5, Flight Inspection Daily Flight Log. In the "Remarks" section of FAA Form 4040-5, indicate, "Snow NOTAM in effect at time of inspection, no discrepancy assigned."

b. If the NOTAM indicates glide slope minima raised to localizer only for Category D aircraft, follow the procedure outlined in paragraph 217.46 above--the only exception being that any out-of-tolerance condition shall generate a discrepancy and the appropriate NOTAM. Restoration flight check shall be scheduled as an "Unscheduled Special (U)."

c. If the glide slope supports Category II/III approach procedures, the glide slope will only be evaluated to Category I tolerances. Restoration of Category II/III facilities, after the snow NOTAM is removed, will be considered as

a periodic overdue inspection in accordance with paragraph 105.2.

d. Monitor check shall not be accomplished while the snow NOTAM is in effect. Flight inspection after the snow NOTAM is canceled shall be considered as a periodic overdue in accordance with paragraph 105.2.

e. If the approach is satisfactory, a Category I periodic check will be complete when a level run to check width and symmetry is accomplished and no out-of-tolerances are found. Entries on FAA Form 4040.5 shall be normal.

Figure 217-3

APPLICATION OF STRUCTURE TOLERANCE -- CAT. II & III

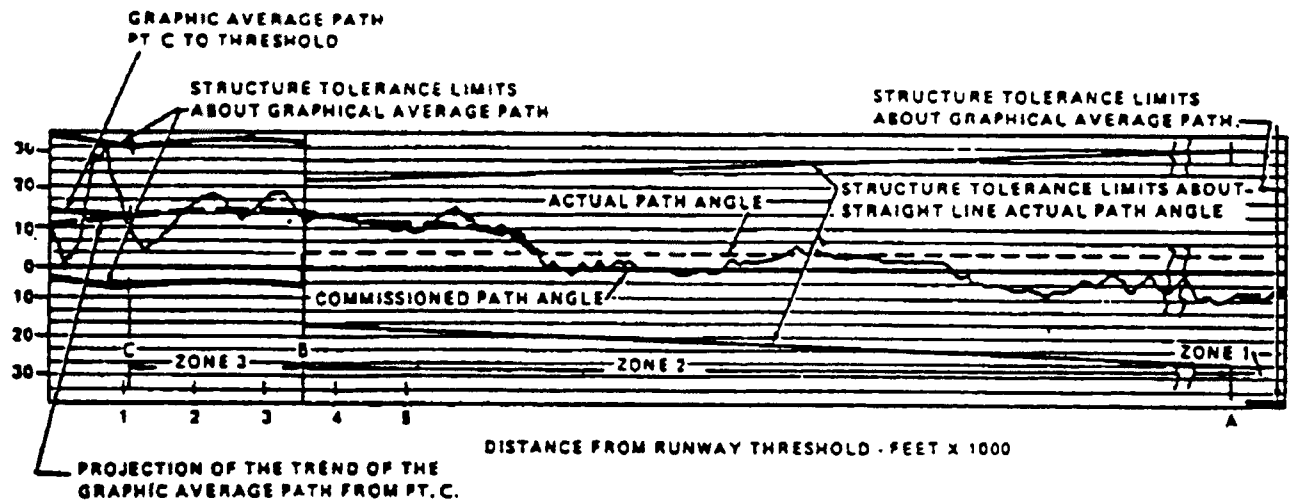
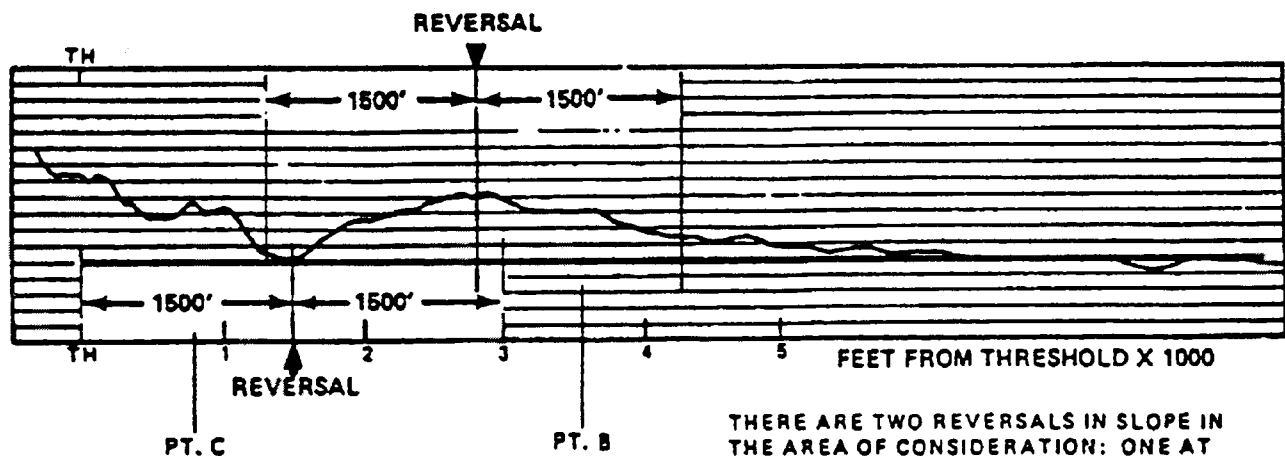


Figure 217-4

RATE OF CHANGE/REVERSAL IN THE SLOPE OF THE GLIDE PATH



217.5 TOLERANCES.

CODES:

C — Tolerances that are applied to site, commissioning, reconfiguration, and categorization inspection.

P — Tolerances that are applied to any inspection subsequent to the inspections outlined in Code C.

a. Localizers.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Spectrum Analysis	Reserved			
Modulation Level	217.3202	X	X	40% \pm 4%
Waveguide Clearance XMTR		X	X	40% \pm 4% (Those facilities which support a back course.)
Power Ratio	217.3204	X		The course transmitter power level shall be at least 10 dB greater than the clearance transmitter.
Phasing	217.3205	As Required		No tolerance.
Width—	217.3206			Maximum—6.0° (SDF-12.0°). CAT II & III tailored to 700 feet. Precision approach—400 feet minimum course width at the threshold.
Front Course		X	X X X	\pm 0.1° of the commissioned width. Within 17% of the commissioned width. CAT III: Within \pm 10% of the commissioned width.
Transmitter Differential (Front Course)		X	X	Not greater than 0.5° or 10% of the commissioned width, whichever is least.
Back Course	217.3206	X	X X	Between 3.0° and 6.0°. Between 2.49° and 7.02° in normal or monitor alarm condition. SDFs — Within 10% of the front course sector width.
Symmetry (Front Course Only)	217.3206	X	X	With the facility in normal: 45-55%.
Alignment Front Course and Independently Monitored Back Courses	217.3207	X	X	Within \pm 3 μ A of the designed procedural azimuth. For ILS's, Localizer-only on centerline and SDFs on centerline. From the designed procedural azimuth: CAT I \pm 15 μ A. CAT II \pm 11 μ A. CAT III \pm 9 μ A. Offset Localizers, LDAs. Offset SDFs \pm 20 μ A. Back Course \pm 20 μ A.
Back Course (Facilities subordinate to front course.)		X	X	Designed procedural azimuth \pm 65 μ A.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Course Structure Front Course	217.3207	X	X	Zone 1—From the average course signal: CAT I, II, III: $\pm 30 \mu\text{A}$ to Point A SDF: $\pm 40 \mu\text{A}$ to Point A Zone 2—From the actual course alignment: CAT I: $\pm 30 \mu\text{A}$ at Point A; linear decrease to $\pm 15 \mu\text{A}$ at Point B. CAT II, III: $\pm 30 \mu\text{A}$ at Point A; linear decrease to $\pm 5 \mu\text{A}$ at Point B. SDF: $\pm 40 \mu\text{A}$ at Point A; linear decrease to $\pm 20 \mu\text{A}$ at Point B. Zone 3—From the actual course alignment: CAT I: $\pm 15 \mu\text{A}$ at Point B; $\pm 15 \mu\text{A}$ at Point C. SDF: $\pm 20 \mu\text{A}$ at Point C.
<p>NOTE 1: Use CAT II tolerances for offset localizers, localizer only, and LDAs.</p> <p>NOTE 2: For localizer only, LDA SDF measure structure from average course alignment.</p>				
	217.3207			Zones 3 & 4—From the actual course alignment. CAT II, III: $\pm 5 \mu\text{A}$ at Point B; $\pm 5 \mu\text{A}$ to Point D. Zone 5—From the actual course alignment. CAT III: $\pm 5 \mu\text{A}$ at Point D; linear increase to $\pm 10 \mu\text{A}$ at Point E.
Back Course		X	X	Zone 1—From the average course signal: $\pm 40 \mu\text{A}$ to Point A. Zone 2—From actual course alignment: $\pm 40 \mu\text{A}$ at Point A; linear decrease to $\pm 20 \mu\text{A}$ at Point B. Zone 3—From actual course alignment $\pm 20 \mu\text{A}$ at Point B; $\pm 20 \mu\text{A}$ at Point C.
Front and Back Course	217.41		X	Exception: An aggregate out-of-tolerance condition for 354 feet may be acceptable in a 7,089-foot segment.
Monitors Alignment Front Course	217.3208			The course alignment monitor shall alarm when the actual course alignment signal shifts from the designed procedural azimuth by no greater than: CAT I ILS and SDFs aligned along runway centerline $\pm 15 \mu\text{A}$ CAT II $\pm 11 \mu\text{A}$ CAT III $\pm 9 \mu\text{A}$.
Facilities aligned along the runway.		X	X	
Offset Localizers, Offset SDFs, and LDAs		X	X	$\pm 20 \mu\text{A}$ from the designed procedural azimuth when using actual course alignment references, i.e., AFIS, theodolite, etc..
Localizers, SDF's, and LDA's where alignment is determined to be satisfactory by visual observations	217.3208a(1)(c)	X	X	$\pm 20 \mu\text{A}$ from established equality of modulation reference.
Back Course		X	X	$\pm 20 \mu\text{A}$ from the alignment achieved at commissioning.
Width Front Course & Independently Monitored Back Courses		X	X	Not more than $\pm 17\%$ of the commissioned width.
RF Power	217.3209	X		Maintained at or above: Signal Strength— $5 \mu\text{V}$ Flag Alarm Current— $240 \mu\text{A}$ Clearance and Structure—in tolerance.
Coverage	217.3211	X	X	At or greater than: Signal Strength— $5 \mu\text{V}$ Flag Alarm Current— $240 \mu\text{A}$ Clearance and Structure—in tolerance Interference—shall not cause an out-of-tolerance condition.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Clearances (Front and Back Course) Facility in Normal configuration.	217.3210	X	X	As measured from the procedural designed azimuth: Sector Minimum Clearance 1 Linear increase to 175 μ A then maintain 175 μ A to 10°. 2 150 μ A (see note). 3 150 μ A (see note). Clearances are reduced 15 μ A from the clearance required in normal.
Facility in any alarm configuration.		X	X	
	217.43	X	X	NOTE: Exceptions are authorized in Sectors 2 and 3.
Polarization	217.3213	X	X	Polarization error not greater than: CAT I \pm 15 μ A CAT II \pm 8 μ A CAT III \pm 5 μ A
Identification and Voice	217.3214	X	X	Clear, correct; audio level of the voice equal to the identification level. The identification shall have no effect on the course. Voice modulation shall not cause more than 5 μ A of course disturbance.

b. Glide Slopes.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Spectrum Analysis	Reserved			
Modulation Level	217.3302	X	X	80% \pm 2% 80% \pm 5%
Modulation Equality	217.3303	As Required		Zero μ A \pm 5 μ A
Phasing and Airborne Phase Verification	217.3304	As Required		No Tolerance
Engineering & Support Tests	217.3305 217.33051 217.33052 217.33053 217.3311	As Required		No Tolerance
Width	217.3306b	X	X	0.7° \pm 0.05° 0.7° \pm 0.2° Site Survey, USAF test van: 0.7° \pm 0.1°
Angle	217.3306a(2) 217.3306a(1)	X	X	Within \pm 0.05° of the commissioned angle. Within + 10.0% to -7.5% of the commissioned angle.
			X	CAT III within \pm 4.0% of commissioned angle. Site Survey, USAF test van: \pm 0.1° of the commissioned angle.
Alignment	217.3310	X	X	CAT I — Not applicable CAT II and III: Zone 3 \pm 37.5 μ A about the commissioned angle at Point B; expanding linearly to \pm 48.75 μ A about the commissioned angle at Point C; expanding linearly to \pm 75 μ A about the commissioned angle at ILS reference datum.
Tilt	217.3309	X	X	Within + 10.0% to -7.5% of the commissioned angle.
Transmitter Differential	217.3306a	X	X	\pm 0.10° \pm 0.20°
Threshold Crossing Height		X		CAT II and III: 50 to 60 ft.
Symmetry	217.3306c	X	X	The following criteria is applied with the facility in a normal configuration: CAT I 67-33%. Broad sector either above or below path. CAT II 58-42%. Broad sector either above or below path. 67-33%. Broad sector below path only. Cat III 58-42%. Broad sector either above or below path.
Structure below Path	217.3306d	X	X	190 μ A of fly-up signal occurs at an angle which is at least 30% of the commissioned angle.
		X	X	Exception: If this tolerance cannot be met, apply clearance procedures and tolerances.

PARAMETER	REFERENCE	INSPECTION		TOLERANCE/LIMIT
		C	P	
Clearance	217.3307	X	X	Adequate obstacle clearance at 180 μ A or greater of fly-up signal in normal (150 μ A or greater in any monitor limit condition).
Below the Path				
Above the Path		X	X	150 μ A of fly-down signal occurs at some point prior to the first false path.
Structure	217.3310 217.41 217.42			
With AFIS or Tracking Device.		X	X	
Zone				Category 1
1				30 μ A from graphical average path.
2				30 μ A from actual path angle.
3				30 μ A from graphical average path
Zone				Category II and III
1				30 μ A from graphical average path.
2				From actual path angle 30 μ A at Point A, then a linear decrease to 20 μ A at Point B.
3				20 μ A from the graphical average path.
Without AFIS or tracking device.	217.23		X	
Zone				Category 1
1				30 μ A from the graphical average path.
2				30 μ A from the graphical average path.
3				30 μ A from the graphical average path.
	217.41		X	Exception: An aggregate out-of-tolerance condition for 354 feet may be acceptable in a 7,089-foot segment.
Change/Reversal	217.42	X	X	25 μ A per 1,000 feet in a 1,500-foot segment.
Coverage	217.3312	X	X	At or greater than: Signal Level: 15 μ V Flag Alarm Current: 240 μ A Fly-up Signal: 150 μ A Clearance and Structure in tolerance. Interference shall not cause an out-of-tolerance condition.
Monitor Reference Values	217.3313			
Angle		X	X	Within + 10.0% to -7.5% of the commissioned angle (applicable to SBR, Wave Guide, and EFGS)
Width		X	X	0.9° maximum. 0.5° minimum.
RF Power	217.3314	X		Not less than: Signal Level—15 μ V.

217.6 Adjustments. See paragraph 106.45. When equipment performance characteristics are abnormal but within tolerances, they should be discussed with maintenance personnel to determine if adjustments will increase the overall

performance of the systems. Following any adjustment to correct an out-of-tolerance condition, the appropriate monitor(s) shall be checked and proper monitor operation verified.

218.3 Flight Inspection Procedures

a. These lighting system configurations are identified as the United States Standard. While there are other approach lighting system configurations in existence, no attempt has been made to describe all systems in this section due to the fact that they are considered as non-standard lighting systems and will not be found in quantity. Where it is necessary to make an in-flight evaluation of non-standard systems, the flight inspector must determine that they fulfill the operational requirements for which they are installed and do not create signals which might be misleading or hazardous.

b. For airports with no prior IFR service or where night minimums are being revised, a night flight inspection shall be conducted to determine the adequacy of the light systems to support the procedure.

c. Approach lights, except semi-flush lights, are aimed vertically to a point on the ILS or PAR glide path 1600 feet in advance of the light; therefore, it is necessary that the aircraft be positioned on the glide path for proper evaluation. For non-precision type navigational facilities, a three-degree glide path angle is simulated for aiming purposes.

218.31 Checklist. The following checks will be performed on flight inspections of approach lighting systems and runway end identifier lights.

- a. Light Intensity
- b. Lamp Alignment
- c. Inoperative Lights
- d. Radio Controlled Lights.

218.32 Detailed Procedures. A commissioning flight inspection is required for all airport lighting systems, including approach lights, REILS, runway lights, and radio control of lights, that support a public-use or military instrument approach procedure. Recurring inspections will be conducted concurrently with the periodic

inspection of the primary navigational facility which the lighting system supports. The periodic inspection of the primary navigational facility will be considered complete if circumstances prohibit inspection of the lighting system, provided all other checklist items have been accomplished satisfactorily.

218.321 Approach Light Systems

(1) **Light Intensity.** The flight inspector will have the approach lighting system sequenced through the normal intensity settings to determine that the relative brightness of each intensity setting is uniform. All light units should be operating with the proper filters in place depending on the type system installed.

(2) **Lamp Alignment.** The electronic glide slope angle will determine the proper aiming points for an Approach Lighting System. It is necessary to position the aircraft on the prescribed glide path to determine if each light and light bar is properly aimed in the system. For non-precision type instrument approaches, the lights and light bars are aimed along a theoretical glide slope angle of three degrees (3.0%). The flight inspector will identify the lights or light bars that are inoperative or misaligned; improper aiming, up or down, can be detected by positioning the aircraft above and below the normal approach path.

(3) **Radio Controlled Lighting Systems.** All radio controlled lighting systems associated with either a precision or non-precision Instrument Approach Procedure will be flight checked for satisfactory operation on commissioning and during subsequent periodic inspections. These light systems are activated and controlled by radio signals generated from an aircraft or a ground facility.

Figure 218-1

RUNWAYS WITH APPROACH LIGHT SYSTEMS					
Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
Approach Lights (Med. Int.)	2	Off	Low	Low	High
Approach Lights (Med. Int.)	3	Off	Low	Med	High
MIRL	3	Off or Low	†	†	†
HIRL	5	Off or Low	†	†	†
VASI	2	Off	◇	◇	◇

† Predetermined intensity step.

◇ Low intensity for night use. High intensity for day use as determined by photocell control.

Figure 218-2

RUNWAYS WITHOUT APPROACH LIGHT SYSTEMS					
Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
MIRL	3	Off or Low	Low	Med	High
HIRL	5	Off or Low	Step 1 or 2	Step 3	Step 5
LIRL	1	Off	On	On	On
VASI☆	2	Off	◇	◇	◇
REIL☆	1	Off	Off	On/Off	On
REIL☆	3	Off	Low	Med	High

◇ Low intensity for night use. High intensity for day use as determined by photocell control.

☆ The control of VASI and/or REIL may be independent of other lighting systems.

218.322 Runway End Identifier Lights. The REIL lights will be checked for synchronization of the two lights and approximate flashing rate of 120 flashes per minute. NOTE: The flashing rate can be measured best by observation from the ground; however, the flight inspector should observe this feature for grossly rapid or slow flashing rate. The aiming of the REIL system will be evaluated during a visual approach, commencing from a distance of two miles from the runway threshold on the runway centerline extended. A descent will be made at a vertical angle not lower than 2.5° (530 feet @ 2 miles) to the runway threshold. The facility will be observed for blinding characteristics and overall effectiveness of the REIL system.

218.4 Flight Inspection Analysis

a. The flight inspector will observe any **malfunction or noticeable defects and report such discrepancies** to the persons responsible for maintenance and control of the facility. It is not intended that discrepancies found during flight inspection will result in restrictions to use of the facility unless a hazard to safety exists. For example, several lamps might be inoperative, obscured or improperly aligned, yet this condition would not have an immediate effect on overall system use. High Intensity Runway Edge Lights, Touchdown Zone, and Runway Centerline lights are required for approval of day/night Category II

Figure 218-1

RUNWAYS WITH APPROACH LIGHT SYSTEMS					
Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
Approach Lights (Med. Int.)	2	Off	Low	Low	High
Approach Lights (Med. Int.)	3	Off	Low	Med	High
MIRL	3	Off or Low	†	†	†
HIRL	5	Off or Low	†	†	†
VASI	2	Off	◇	◇	◇

† Predetermined intensity step.

◇ Low intensity for night use. High intensity for day use as determined by photocell control.

Figure 218-2

RUNWAYS WITHOUT APPROACH LIGHT SYSTEMS					
Lighting System	No. of Int. Steps	Status During Nonuse Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
MIRL	3	Off or Low	Low	Med	High
HIRL	5	Off or Low	Step 1 or 2	Step 3	Step 5
LIRL	1	Off	On	On	On
VASI☆	2	Off	◇	◇	◇
REIL☆	1	Off	Off	On/Off	On
REIL☆	3	Off	Low	Med	High

◇ Low intensity for night use. High intensity for day use as determined by photocell control.

☆ The control of VASI and/or REIL may be independent of other lighting systems.

218.322 Runway End Identifier Lights. The REIL lights will be checked for synchronization of the two lights and approximate flashing rate of 120 flashes per minute. NOTE: The flashing rate can be measured best by observation from the ground; however, the flight inspector should observe this feature for grossly rapid or slow flashing rate. The aiming of the REIL system will be evaluated during a visual approach, commencing from a distance of two miles from the runway threshold on the runway centerline extended. A descent will be made at a vertical angle not lower than 2.5° (530 feet @ 2 miles) to the runway threshold. The facility will be observed for blinding characteristics and overall effectiveness of the REIL system.

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SECTION 220. MICROWAVE LANDING SYSTEMS (MLS)

220.1 INTRODUCTION. This section details the flight inspection procedures and tolerances to be applied to microwave landing systems (MLS).

220.2 PREFLIGHT REQUIREMENTS.

a. Review of all facility data and computation of facility error budget.

b. Review of facility horizontal and vertical terrain and obstruction profiles to determine line-of-sight characteristics and areas of possible signal anomalies. These profiles will be provided by installation engineering personnel.

220.3 FLIGHT INSPECTION PROCEDURES.

220.31 Checklist.

TYPE OF CHECK	REF PARA 220.xxx	C	P	PM
Azimuth/Elevation ARC 20 nm	.3201	1		
Azimuth/Elevation ARC 10 nm.	.3202	1	X	X
Vertical Coverage Elevation/Azimuth	.3203	X	2	2
Azimuth Approach	.3204	1	X	X
Elevation Approach	.3204	1	X	X
Azimuth Monitor References	.3205b(1)	X		2
Elevation Monitor References	.3205b(2)	X		2
Low Angle Elevation Clearance	.3205c	X		2
OCI Orbit	.3206	X		
Identification	.3207	X	X	X
DME	.53c	X	X	X

NOTES:

1. Minimum RF Power
2. Engineering or maintenance request

220.32 Detailed Procedures.

220.3201 Standard Service Volume (SSV) or Expanded Service Volume (ESV) Arc.

a. **Purpose:** A commissioning inspection maneuver to define and certify the operational range, lateral and vertical limits of the MLS service volume. Perform the inspection with the facility operating at the lowest computed power required to establish adequate signal coverage.

b. **Positioning.** The lateral limits of the SSV encompasses an arc of ± 40 degrees of proportional guidance about the azimuth antenna phase center at a distance of 20 nm from the approach reference datum (ARD). Using the elevation of the ARD as the reference, the vertical limits extend from 0.9 degree above the horizon to 20,000 feet AGL at 20 nm. Facilities that provide service beyond 20 nm and/or beyond ± 40 degrees shall be considered as an ESV. Start the arc at the maximum usable distance and 5 degrees outside proportional guidance limit. Maintain an altitude equal to the minimum glide path (MGP). If signal coverage of all MLS components cannot be maintained at the MGP, the MLS shall be restricted. There is no requirement to certify the lower, 0.9 degree, or higher, 20,000 feet, limits of vertical coverage unless procedurally or operationally required. DOD MMLS facilities are designed for 15 nm Service Volume. In addition, the RF power of the MMLS is monitored but not adjustable. A 20 nm arc flown at the normal RF power will simulate the power alarm condition. All DOD MMLS facilities shall be restricted beyond 15 nm.

c. Inspection.

(1) Evaluate the proportional guidance service volume in 10 degree increments. There shall be no less than 10 degrees proportional guidance either side of the procedural on course.

(2) While traversing the azimuth proportional guidance sectors, record azimuth and elevation deviation. Deviation crosspointer fluctuations greater than 0.5 degree that exceed 2 degrees of arc shall be validated by radial flight using the procedures outlined in paragraph 220.3203 (Vertical Coverage).

220.3202 Low Altitude Arc.

a. **Purpose.** A commissioning and periodic arc throughout the proportional guidance area to assure azimuth and elevation signal coverage at the lower edge of elevation deflection sensitivity.

b. Positioning. At a distance of between 5 and 10 nm from the ARD, start the arc 5 degrees outside the edge of the proportional guidance service volume. Vertical altitude shall be computed to equal the MGP x 0.75. The distance and altitude at which the arc is flown on commissioning will be recorded in AMIS. This shall be the reference for periodic evaluations.

c. Inspection.

(1) Evaluate the proportional guidance volume in 10-degree increments. There shall be no less than 10 degrees proportional guidance either side of the procedural on course.

(2) While traversing the proportional guidance sectors, record azimuth and elevation deviation. Deviation crosspointer fluctuations greater than 0.5 degree that exceed 2 degrees of arc shall be validated by radial flight using the procedures outlined in paragraph 220.3203 (Vertical Coverage).

220.3203 Vertical Coverage.

a. Purpose.

(1) A commissioning maneuver to evaluate vertical coverage of the azimuth and elevation on the procedural azimuth and at ± 10 degrees each side.

(2) Validate elevation and azimuth deviation crosspointer fluctuations noted on arcs.

b. Positioning. This check will be accomplished by a level run starting at 20 nm or ESV limits, whichever is farthest from the ARD. Start altitude shall be computed to equal the MGP x 0.75 at the FAF. Altitudes up to the MGP are acceptable outside the FAF if required to maintain signal integrity. Inside the FAF, the altitude shall be no higher than that equal to the MGP x 0.75.

c. Inspection. Record deviation, PFE, PFN, and CMN crosspointers. Observe the azimuth crosspointer for excessive signal aberrations which may indicate multipath or signal shadowing. Observe the elevation crosspointer for a smooth linear transition terminating between 15 and 20 degrees.

(1) When fluctuations exceed ± 0.5 degree within ± 10 degrees of the procedural on course, fly the approach offset 5 degrees each side of

the procedural on course and apply PFN and CMN tolerances.

(2) Validation of deviations noted on arcs shall be discussed with maintenance personnel for corrective action. If not correctable, the area in question shall be restricted.

220.3204 MLS Approaches.

a. Purpose. This maneuver is performed to verify that the azimuth and elevation facilities will satisfactorily support the proposed or published approach and categories of intended use. The approach should be the first maneuver flown during a commissioning, reconfiguration, or restoration flight inspection, so that the azimuth and elevation course may be optimized to the desired procedural alignment.

b. Positioning. Approaches shall be evaluated on the designed procedural azimuth and the minimum glidepath unless otherwise indicated. For the purpose of evaluating structure, optimizing azimuth and elevation alignments, and conducting periodic inspections, start the approach at a distance not closer than the published FAF point or 6 miles from runway threshold, whichever is greater. For commissioning, fly an approach from the desired service volume limits on the MGP while the facility is at minimum RF power.

c. MLS Approaches Which Support Azimuth Only Minima. For an azimuth-only approach, the published or proposed procedural altitudes shall be maintained in each segment, except the final segment shall be flown as follows: Upon reaching the FAF inbound, descend at a rate of approximately 400 feet per mile (930 feet per minute at 140 knots; 800 feet per minute at 120 knots) to an altitude of 100 feet below the lowest published MDA and maintain this altitude to the MAP.

d. Inspection.

(1) Azimuth facilities sited along runway centerline shall be evaluated to the ARD. All other facilities shall be evaluated to the MAP. Approved RTT and/or AFIS methods shall be used for the approach evaluation. RTT Analysis shall utilize the techniques from paragraphs 217.3207 and 217.3306. The facility error budget will provide all tolerances to be used during commissioning and periodic flight inspection. Mean course error (MCE) shall be

established prior to application of PFE tolerances. Evaluate DME distance accuracy. Exclude data in areas that are restricted due to facility performance.

(2) Visual Autoland or Category II or III Operations Authorized. On commissioning inspections, fly the aircraft directly over the runway centerline at threshold, touch down prior to point "D", and remain over centerline to point "E". This allows the recorder "0" reference line to be used as the position reference for structure evaluation. Complete the runway evaluation by taxiing the aircraft on centerline from threshold to point "E". An additional MLS-3 approach accomplished with normal updates will then provide a comparative to allow periodic airborne evaluation of the rollout guidance.

(3) On commissioning inspections or inspections to certify changes to final approach course, the procedural alignment of computed centerline or MLS RNAV approaches shall be verified using a receiver capable of generating a computed centerline. For periodic SIAP and COV checks, a standard receiver may be used, providing the following conditions are met:

(a) Azimuth boresight is parallel to, and offset no more than 400 ft from, the procedural centerline.

(b) Azimuth boresight alignment is within the tolerances specified in Paragraph 220.52d.

(c) Basic and Auxiliary Data words affecting azimuth determination match those used during final approach course certification of the current SIAP.

220.3205 Monitor References.

a. Purpose. To provide facility maintenance personnel reference readings to be used in the validation of facility monitoring parameters. Facility discrepancies shall be assigned if the shift exceeds the PFE allowance at the ARD and/or MAP reference point, as applicable. Mobile Microwave Landing System (MMLS) AZ and EL monitor limits shall be evaluated at the actual alarm points.

b. Inspection.

(1) Azimuth monitor references shall be established after the facility is optimized to a MCE within ± 0.02 degree of the procedural on course azimuth. After the MCE is established,

have maintenance personnel shift the system to one side, record the reference, shift the same amount to the other side, record the reference, then restore to normal. Azimuth monitors can also be established on the ground when parked within proportional guidance and no closer than 1,000 feet to the facility.

(2) Elevation monitor references are established airborne and require the MGP to be established within ± 0.02 degree of the desired angle prior to accomplishment. Request an elevation angle change of no greater than 0.10 degree high, record the reference, have the elevation angle changed to no greater than 0.10 degree low, record the reference, then restore to normal.

c. Elevation Clearance Evaluation.

Perform this check during a commissioning flight inspection when in low angle alarm. Three runs are required, one on centerline, and at 2 degrees either side of centerline. Fly at an angle equal to $[(MGP^0 \times 0.75) - 0.25^0]$. Ensure that adequate course guidance and obstacle clearance can be maintained from the FAF to the MAP.

220.3206 Out-of-Coverage Indication (OCI).

The purpose of the OCI check is to ensure that no false angle decoding occurs outside of proportional guidance coverage areas. Fly an orbit radius of 6 to 10 miles about the azimuth facility for this check. The aircraft will be flown at an altitude as close to the MGP that line of site with the MLS facilities will allow. During the orbit, note the position of any decoded angles lasting longer than 4 seconds or 1.5 degrees of arc, whichever is greater. Return to the area after completing the orbit and manually program the decoded angle into the receiver. If the angle can be locked onto and flown as a radial, OCI is present and shall be corrected or the facility restricted.

220.3207 Identification. The purpose of the identification check is to ensure correct identification is received throughout the coverage area. The identification can be validated by listening to the Morse code or recording basic data word 6.

220.4 ANALYSIS.

a. Azimuth PFE, PFN, and CMN will be evaluated over any 40-second interval of radial flight within the coverage area. Measured parameters shall be in tolerance for no less than 95 percent of the interval measured. PFE tolerances shall only be applied with use of AFIS or RTT.

b. Elevation PFE, PFN, and CMN will be evaluated over any 10-second interval of radial flight within the coverage area when on a selected glide path at or above the MGP. Measured parameters shall be in tolerance for no less than 95 percent of the interval measured. PFE tolerances shall only be applied with use of AFIS or RTT when flown radially.

c. Manual analysis of PFN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration greater than:

- (1) 6.3 seconds for azimuth
- (2) 2 seconds for elevation

d. Manual analysis of CMN can be determined by measuring the signal deviations from the mean azimuth or elevation angle that have a duration less than:

- (1) 10.4 seconds for azimuth
- (2) 6.3 seconds for elevation

(3) CMN filter bandpass frequency overlaps a portion of the PFE bandpass frequency. The resultant CMN signal will be superimposed upon the PFE component, resulting in a larger error than is actually present. CMN shall be reported after subtraction of the PFE component.

220.5 TOLERANCES.

220.51 Facility Error Budgets. Due to the unique siting requirements of each MLS installation and the resulting difference in tolerances, a MLS error budget shall be computed for each facility. The location of the azimuth site determines the Reference Point to be used in the computation of the error budget.

a. **ARD** when the azimuth is sited along runway centerline. (See Figure 220-3).

b. **MAP** when the azimuth is:

- (1) Offset. (See Figure 220-4).
- (2) Co-located azimuth with elevation. (See Figure 220-5).
- (3) Heliports which are considered to be those facilities with less than 2,300 feet between the azimuth and the approach reference datum when sited along runway centerline.

(4) Non-precision approach aid terminating at a point in space and not aligned with a precision runway. (See Figure 220-6.)

220.52 Azimuth.

a. **Purpose.** During commissioning and categorization flight checks, the MCE shall be aligned to within ± 0.02 degree of the procedural on course. On commissioning, or categorization flight checks, PFE tolerances will not be applied until the MCE for both the azimuth and elevation has been optimized.

b. **Alignment** shall be reported as the average flight inspection angle. Facilities found with an alignment that exceeds 60% of the allowable PFE shall generate a maintenance alert IAW Para 217.45b. Facilities shall not be NOTAMed unless the PFE allowance at the reference point is exceeded.

c. **Azimuth sited along runway centerline.**

(1) PFE = 20 feet not to exceed 0.25 degree referenced to the ARD

(2) PFN = 11.5 feet not to exceed 0.25 degree referenced to the ARD

(3) The CMN limit shall not exceed ± 0.10 degree in any coverage region within ± 10 degrees of runway centerline extended nor exceed ± 0.20 degree in any other region within coverage.

(4) Zone 4 and 5 PFE, PFN, and CMN shall be the same as that at ARD.

d. **Offset azimuth, co-located azimuth with elevation, and heliports:**

(1) PFE = 28 feet not to exceed 0.50 degree as referenced to the MAP

(2) PFN = 14 feet not to exceed 0.50 degree as referenced to the MAP

(3) CMN not to exceed 0.20 degree

e. **Facilities Not Aligned as a Precision Approach Aid to a Runway.**

(1) PFE = No requirement

(2) PFN = 0.50 degree

(3) CMN not to exceed 0.20 degree

(4) Alignment shall be considered satisfactory when the flight inspector determines that the azimuth on course and elevation rate of descent allow safe completion of the procedure as published.

220.53 Elevation.

a. Purpose. During commissioning and categorization flight checks, the MCE shall be aligned to within ± 0.02 degree of the procedural on course. On commissioning, or categorization flight checks, PFE tolerances will not be applied until the MCE for both the azimuth and elevation has been optimized.

b. Alignment shall be reported as the average flight inspection angle. Facilities found with an alignment that exceeds 60% of the allowable PFE shall generate a maintenance alert IAW Para 217.45b. Facilities shall not be NOTAMed unless the PFE allowance at the reference point is exceeded.

(1) PFE = 0.133 degree at the MLS reference point for a standard 3.0 degree angle. For angles above 3.00 degrees by a factor of (0.133 + 0.022 per degree).

(2) PFN = 0.087 degree at the MLS reference point for a standard 3.0 degree angle.

For angles above 3.00 degrees by a factor of (0.087 + .0145 per degree)

(3) The CMN limit shall not exceed ± 0.10 degree in any coverage region within ± 10 degrees of runway centerline extended nor exceed ± 0.20 degree in any other region within coverage.

c. DME. The DME shall be evaluated as a DME/N throughout all areas of coverage.

d. Degradation Factors.

(1) Azimuth sited along runway centerline:

(a) With distance: The PFE and PFN limits, expressed in angular terms along the runway centerline, are 1.2 times the value at the ARD to a maximum of 0.25 degree at 20 nm from the ARD.

(b) With azimuth angle: The PFE and PFN limits expressed in angular terms at ± 40 degrees azimuth angle are 1.5 times the value on the extended runway centerline at the same

distance from the ARD, to a maximum of 0.25 degree.

(c) With elevation angle below 9.0 degrees, no degradation allowed. From + 9 degrees to + 15 degrees, by a factor of 1.5 for the PFE and PFN limits to a maximum of 0.5 degree.

(2) Offset azimuth, co-located azimuth with elevation, and heliports:

(a) With distance: The PFE and PFN limits, expressed in angular terms along the procedural azimuth, are 1.2 times the value at the MAP to a maximum of 0.50 degree at 20 nm from the ARD.

(b) With azimuth angle: The PFE and PFN limits expressed in angular terms at ± 40 degrees azimuth angle, are 1.5 times the value on the extended runway centerline at the same distance from the MAP to a maximum of 0.5 degree.

(c) With elevation angle from + 9 degrees to + 15 degrees, by a factor of 1.5 for the PFE and PFN limits.

(3) Elevation:

(a) With distance: The PFE and PFN limit, expressed in angular terms along the runway centerline, are 1.2 times the value at the ARD.

(b) With azimuth angle: The PFE and PFN limits expressed in angular terms at ± 40 degrees azimuth angle are 1.5 times the value on the extended runway centerline at the same distance from the ARD.

(c) With increasing elevation angles: The PFE and PFN limits are degraded linearly from + 3 degrees to + 15 degrees, by a factor of 2.0 times the value at the ARD.

(d) With decreasing elevation angle: The PFE and PFN limits from + 3 degrees (or 60 percent of the MGP, whichever is less) to the coverage extreme are degraded linearly by a factor of 3 times the value at the ARD.

e. Basic Data Words (BDW) are associated with the operation of the landing guidance system. Essential basic data words are 1, 2, 3, 4, and 6.

f. Auxiliary Data Words (Aux Data) provides information used for RNAV approaches. Essential aux data words are 1, 2, and 3. Facilities sited to support Category II/III autoland or RNAV curved approach procedures shall radiate correct aux data.

g. Out-of-Coverage Indications (OCI) shall be eliminated or the MLS restricted for use.

h. Identification shall be correct and distinct throughout the coverage area. Decoded basic data word 6 shall match transmitted Morse code identification.

220.54 MILITARY ONLY USE: MLS facilities deployed to support military operations shall not exceed the following parameters as computed to a reference datum point about the desired decision height. These tolerances apply to category I type facilities only. All other parameters remain as stated in paragraph 220.53.

a. During commissioning and monitor reference checks, the mean course error shall be aligned to within .05 degrees for both the desired Azimuth procedural on course and desired Elevation minimum glide path.

b. Azimuth path following error (PFE) shall not exceed 35 feet at the reference datum point. When the angular value for 35 feet at the reference point exceeds 0.5 degrees, the angular value of 0.5 degrees shall become the limit. PFE shall not exceed an angular value of 0.5 degrees within the desired service volume.

c. Elevation PFE shall not exceed an angular value of 0.2 degrees from the desired minimum glide path.

d. Path following noise for the Azimuth or Elevation shall not exceed 66% of the maximum allowable path following error.

e. Control motion noise shall not exceed 0.2 degrees within the usable service volume.

f. Proportional guidance shall be determined by the installation personnel but shall be no less than that required to support:

(1) A co-located system providing data for a computed course centerline approach. The angular track from the azimuth to the threshold of the runway under evaluation, plus 5 degrees, and

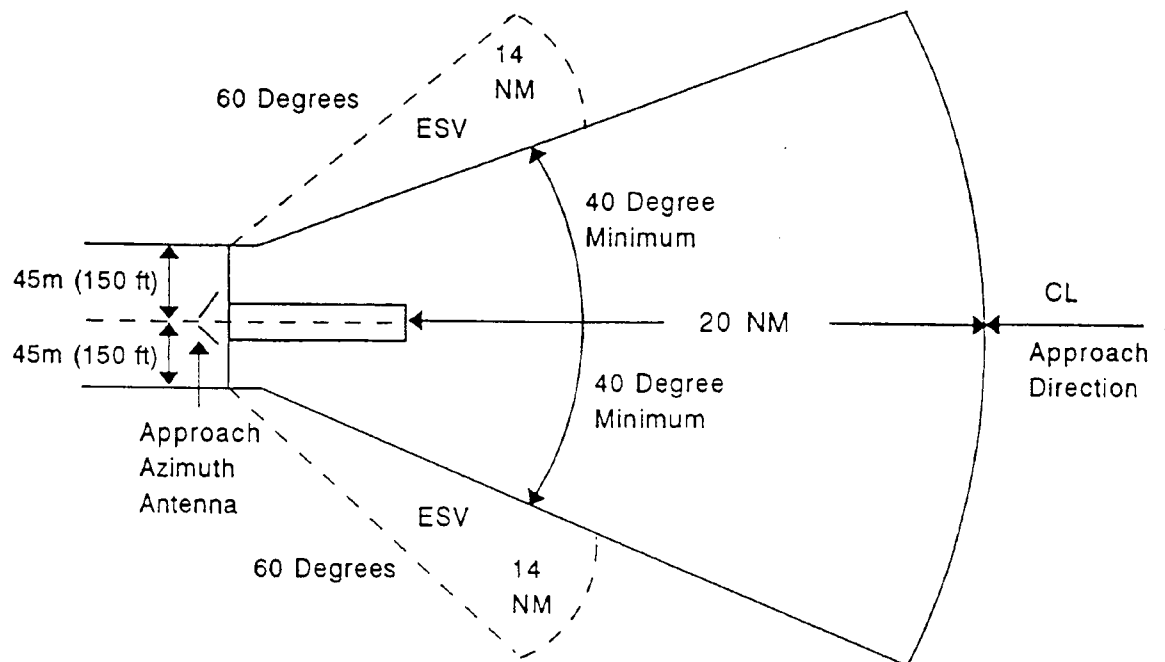
(2) For any system no less than 10 degrees either side of the procedural on course as referenced to the missed approach point.

g. OCI orbits may be deleted when there is positive guidance to the front course proportional guidance area.

h. Standard service volume radial and arc requirements may be modified to the limit required by the procedure plus 2 miles.

Figure 220-1

APPROACH AZIMUTH/DATA COVERAGE HORIZONTAL COVERAGE



VERTICAL COVERAGE

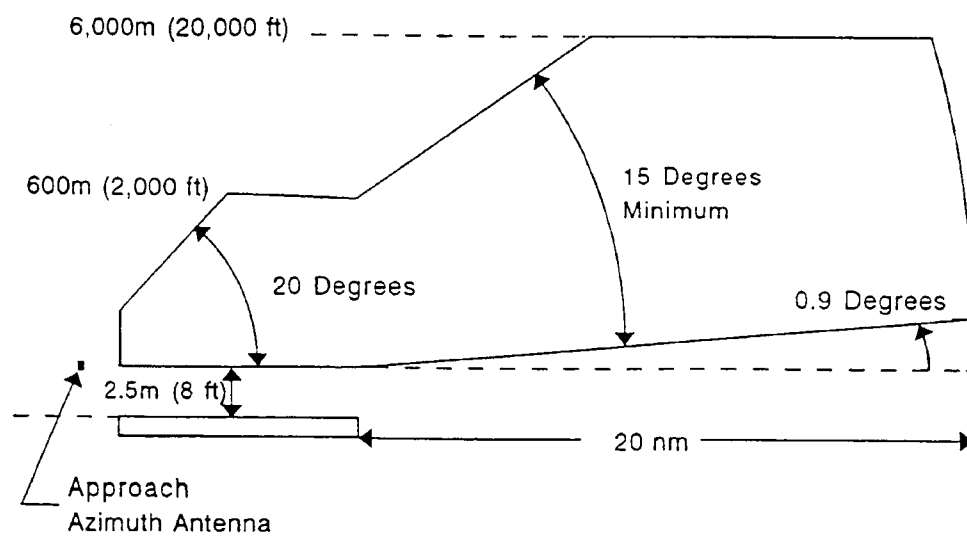
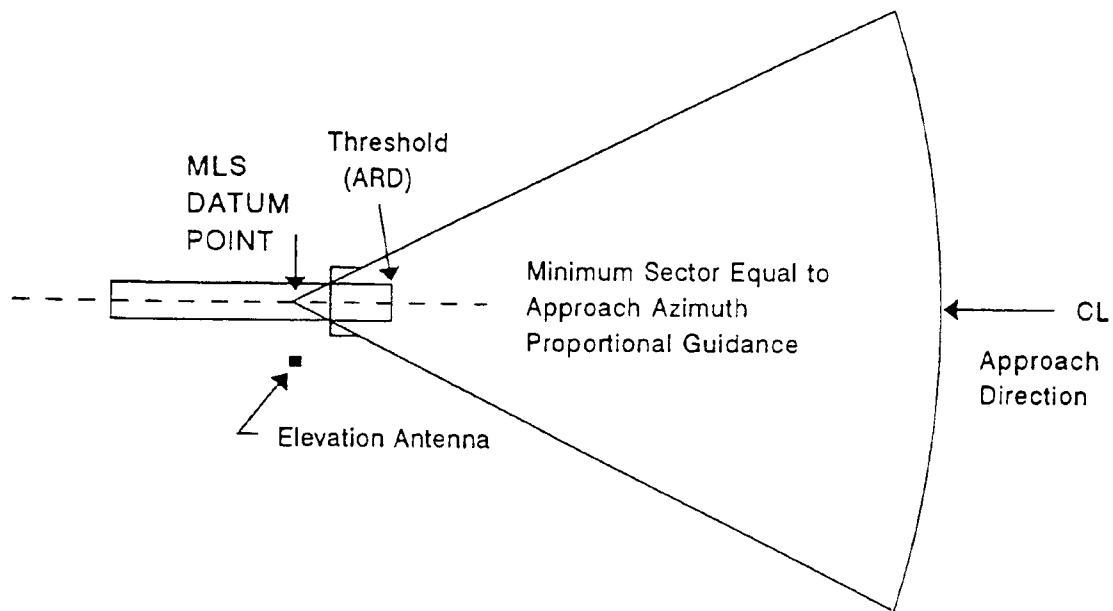


Figure 220-2

APPROACH ELEVATION COVERAGE HORIZONTAL COVERAGE



VERTICAL COVERAGE

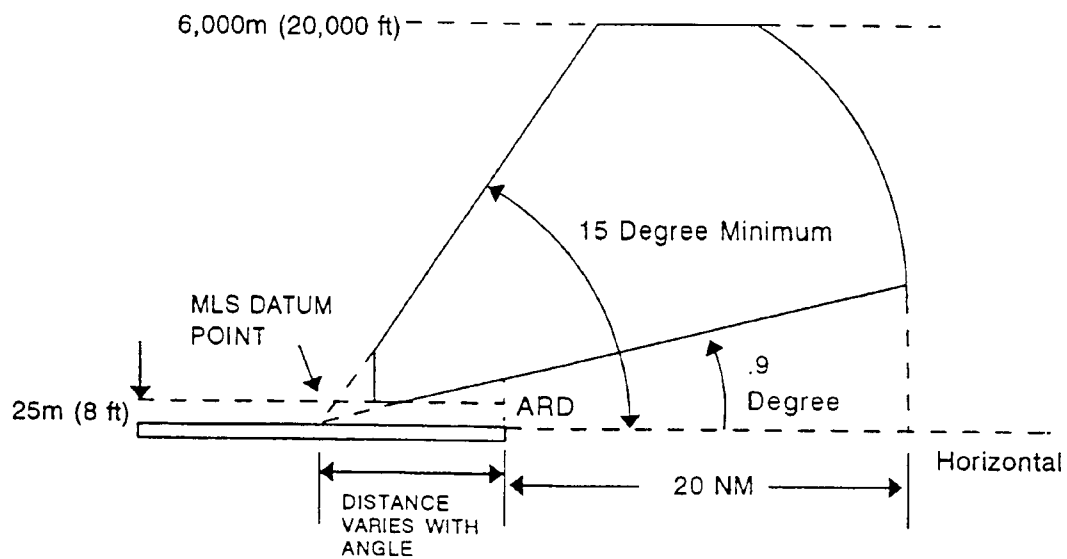
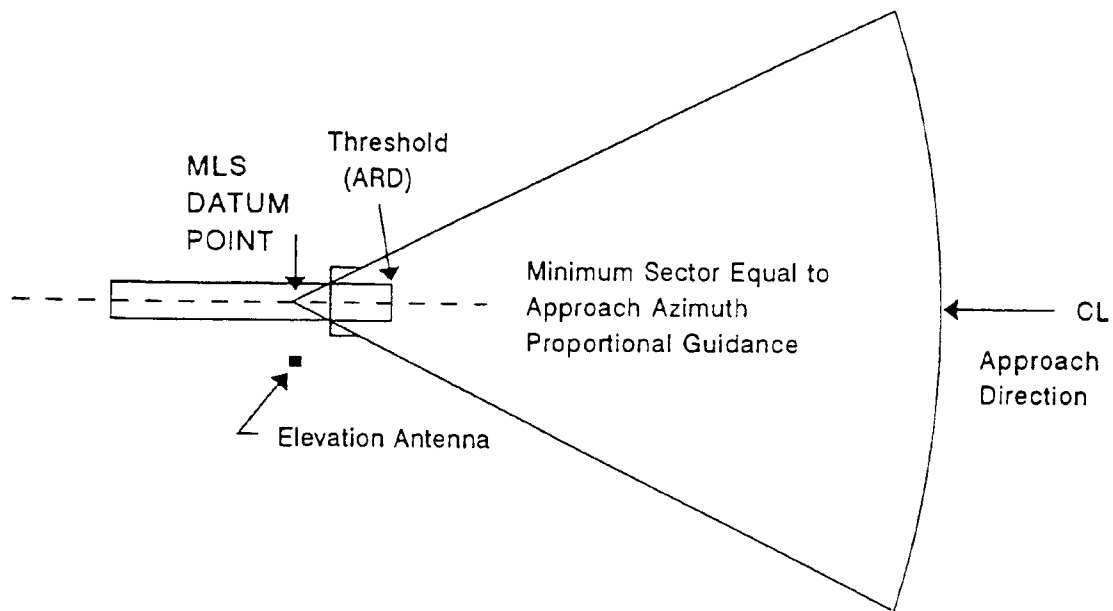
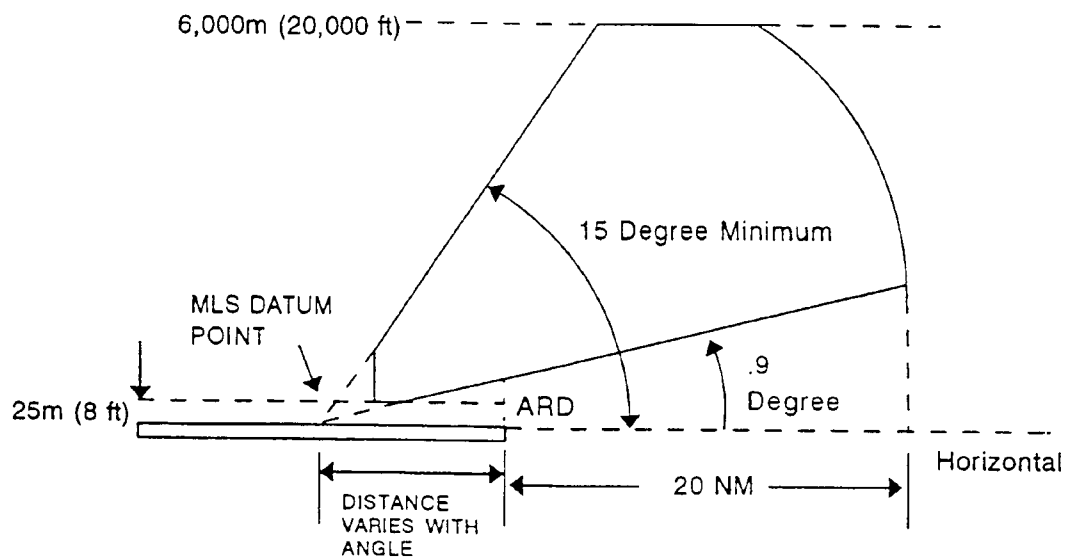


Figure 220-2

APPROACH ELEVATION COVERAGE HORIZONTAL COVERAGE



VERTICAL COVERAGE



MLS POINTS AND ZONES, CONTINUED

Figure 220-5

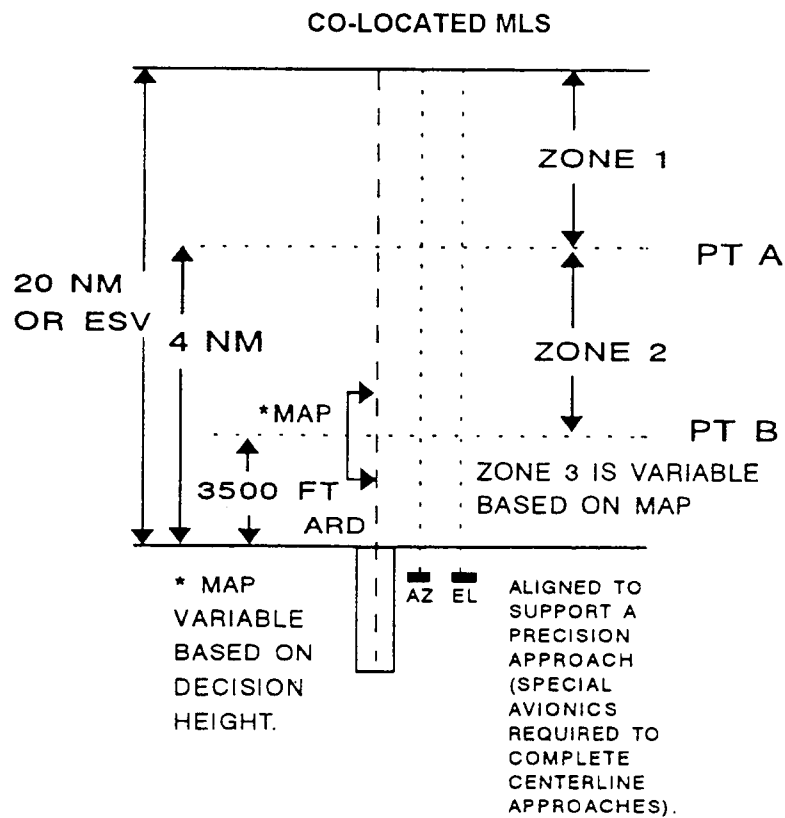
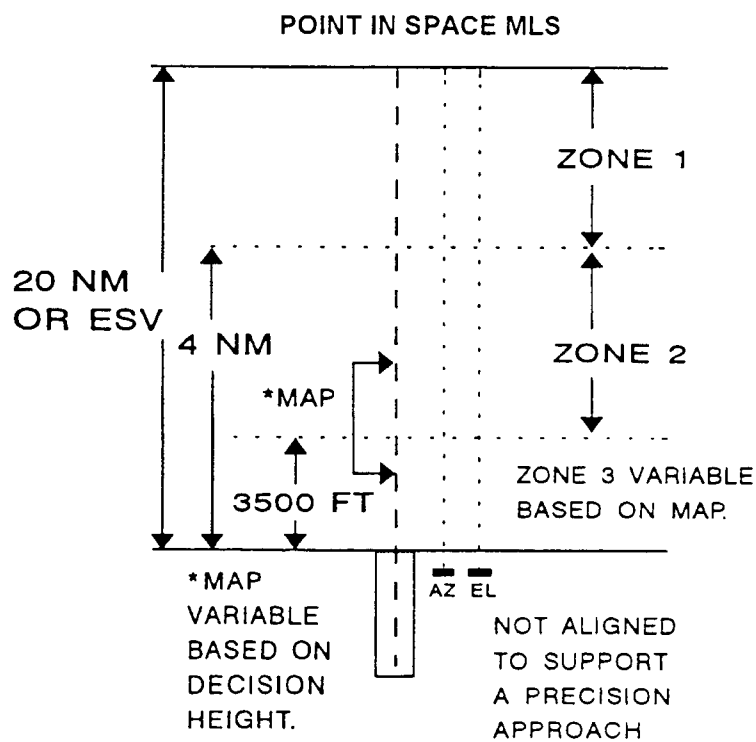


Figure 220-6



Video Map. An electronic displayed map on the radar display that may depict data such as airports, heliports, runway centerline extensions, hospital emergency landing areas, NAVAIDs and fixes, reporting points, airway/route centerlines, boundaries, handoff points, special use tracks, obstructions, prominent geographic features, map alignment indicators, range accuracy marks, and minimum vectoring altitudes (AIM)

Visual Descent Point (VDP). The visual descent point is a defined point on the final approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference is established. (AIM)

VORTAC. A facility composed of azimuthal information from both VOR and TACAN, plus distance information of TACAN.

VOT—Standard. See Standard VOT.

VOT—Area Use. See Area VOT.

VOT Reference Point. A point on or above an airport at which the signal strength of a VOT is established and subsequently checked (applies to both standard and area VOTs).

Waveform. The shape of the wave obtained when instantaneous values of an a.c. quantity are plotted against time in rectangular coordinates.

Waveguide. A hollow pipe usually of rectangular cross section used to transmit or conduct RF energy.

Wavelength. The distance usually expressed in meters traveled by a wave during the timer interval of one complete cycle. Equal to the velocity divided by the frequency.

9960 Hz Voltage. A voltage derived from the VOR 9960 amplitude modulation by the reference channel of the VOR receiver. The 9960 Hz AM is a subcarrier which is frequency modulated by the 30Hz reference. Also referred to the 10 kHz sub-carrier.

301.2 ABBREVIATIONS, ACRONYMS, AND LETTER SYMBOLS.

A : Ampere
a.c. : alternating current
AC : advisory circular
ADF : automatic direction finding
ADP : automatic data processing

AER : approach end of runway
AF : Airway Facilities
AFB : Air Force Base
AFC : automatic frequency control
AFIS : automated flight inspection system
AGC : automatic gain control
AGL : above ground level
AIM : Airmen's Information Manual
air : airborne
align : alignment
ALS : approach lighting system
ALSF : approach lighting system with sequenced flashing lights
am. : ammeter
AM : amplitude modulation
amp : Ampere
ANF : air navigation facility
ant : antenna
APPCON : approach control
ARAC : Army radar approach control
ARD : approach reference datum
ARG : auxiliary reference group
ARR : automated flight inspection system reference radial
ARSR : air route surveillance radar
ARTCC : air route traffic control center
ARTS : automated radar terminal system
ASOS : automated surface aviation observing system
ASR : airport surveillance radar
AT : air traffic
ATC : air traffic control
ATCRBS : Air Traffic Control Radar Beacon System
ATIS : Automatic Terminal Information Service
ATKER : along track error
AVN : Office of Aviation System Standards
AWOS : automatic weather observation system
az : azimuth
Az-EI : azimuth-elevation
BAZ : back azimuth horizontal guidance
BCM : back course marker
bcn : beacon
BFTA : beacon false target analysis
BPS : bits per second
BIT : a digit in a binary coded decimal
BRITE : brite radar indicator tower equipment
BUEC : backup emergency communications
BW : beam width
c : centi (=10⁻²)
C : Celsius
°C : degrees Celsius
C/A code : coarse/acquisition code
cal : calibrate, calibrated
CAS : calibrated airspeed

CAT	: category	etc.	: etcetera (and the rest; and so forth)
CCW	: counterclockwise	F	: Fahrenheit
CD	: common digitizer	°F	: degrees Fahrenheit
CDI	: course deviation indicator	FAA	: Federal Aviation Administration
CDU	: control display unit	FAC	: final approach course
CHAIN	: a group of Loran C stations	FAF	: final approach fix
chan	: channel	FANS	: Future Air Navigation System (ICAO)
chg	: change	FAP	: final approach point
CIC	: combat information center	FAR	: Federal Aviation Regulations
CL	: centerline	FAS	: final approach segment
Comm	: Commission	FAWP	: final approach waypoint
CMN	: control motion noise	FBWP	: flyby waypoint
COMDIG	: common digitizer data reduction	FIO	: flight inspection office
COMLO	: compass locator	FIP	: Flight Inspection and Procedures (staff)
CONUS	: continental United States	fig.	: figure
COP	: change-over-point	FM	: fan marker
CTOL	: conventional takeoff and landing	FM	: frequency modulation
CP	: circular polarization	FMS	: flight management system
CW	: clockwise	FOWP	: flyover waypoint
d	: deci (=10 ⁻¹)	freq	: frequency
DAME	: distance azimuth measuring equipment	FSS	: flight service station
db	: decibel	FTC	: fast time constant
dB/Hz	: Decibel/Hertz	G	: giga (=10 ⁹)
dbm	: decibel referred to 1 milliwatt	galv	: galvanometers
DBRITE	: Digital Bright Radar Indicator Tower Equipment	GCA	: ground controlled approach
dbw	: decibel referred to 1 watt	GDOP	: geometric dilution of precision
d.c.	: direct current	GHz	: gigahertz
DDM	: difference in depth of modulation	govt.	: government
DF	: direction finding	gnd	: ground
DGPS	: differential global positioning system	GNSS	: Global Navigation Satellite System
DH	: decision height	GPI	: ground point of intercept
disc	: discrepancy	GRI	: ground repetition interval
DME	: distance measuring equipment	GS	: glide slope
DME/P	: distance measuring equipment/precision	GSI	: glide slope intercept altitude (Point)
DOD	: Department of Defense	GTC	: gain time control
DOT	: Department of Transportation	h	: hecto (-10 ²); hour
DPSK	: differential phase shift keying	H	: homer
DVOR	: doppler very high frequency omnidirectional range	HAA	: height above airport elevation
E.	: East	HAT	: height above touchdown
EARTS	: en route automated radar tracking service	H-Class	: high altitude
ECD	: envelope to cycle discrepancy (difference)	HDOP	: horizontal dilution of precision
ECOM	: enroute communications	HF	: high frequency
ECM	: electronic counter measures	HF/DF	: high frequency/direction finding
EFIS	: electronic flight instrument system	HFOM	: horizontal figure of merit
e.g.	: exempli gratia (for example)	HIRLS	: high intensity runway lighting system
el	: elevation	Hz	: Hertz
ESV	: expanded service volume	IAC	: initial approach course
et al.	: et alibi (and elsewhere; et alii (and others)	IAF	: initial approach fix
		IAS	: indicated airspeed
		IAPW	: initial approach waypoint

IC	: intermediate course	MALSF	: medium intensity approach lights; sequenced flashing lights
ICAO	: International Civil Aviation Organization	MALSR	: same as MALSF; runway alignment indicator lights
IIC	: investigator-in-charge	MAP	: missed approach point
ID	: identification	MATWP	: missed approach turning waypoint
i.e.	: id est (that is)	MAWP	: missed approach waypoint
IF	: intermediate fix	MB	: marker beacon
IFIO	: International Flight Inspection Office	MCA	: minimum crossing altitude
IFR	: Instrument Flight Rules	MDA	: minimum descent altitude
IFSS	: international flight service stations	MDP	: MLS datum point
ILS	: instrument landing system	MEA	: minimum en route altitude
IM	: inner marker	MF	: medium frequency
INS	: inertial navigation system	MHA	: minimum holding altitude
IO	: input-output	Mhz	: megahertz
IRU	: inertial reference unit	MIRL	: medium intensity runway lights
ips	: inches per second	MLS	: microwave landing system
ISLS	: improved side lobe suppression	MM	: middle marker
IWP	: intermediate waypoint	MOCA	: minimum obstruction clearance altitude
JAI	: joint acceptance inspection	MRA	: minimum reception altitude
JSS	: joint surveillance site	MOPS	: minimum operational performance standards
k	: Kilo ($=10^3$)	MRG	: main reference group
kHz	: kilohertz	MSG	: minimum selectable glidepath
KLAS	: knots indicated airspeed	MSL	: mean sea level
kn	: knots	MTD	: moving target detection
kW	: kilowatt	MTI	: moving target indicator
LAM	: local area monitor	MTR	: mission test report
lat.	: latitude	MSAW	: minimum safe altitude warning
LCA	: lowest coverage altitude	MUA	: maximum usable altitude
L-Class	: low altitude VOR	mV	: millivolt
LDA	: localizer directional aid	MVA	: minimum vectoring altitude
LDIN	: lead-in lights	MVAR	: magnetic variation
LEPP	: live environment performance program	n	: nano ($=10^{-9}$)
LF	: low frequency	N.	: North
LMM	: compass locator at middle marker	NA	: not applicable or not authorized (when applied to instrument approach procedures)
LOC	: localizer	NAS	: National Airspace System
LOM	: compass locator at outer marker	NAVAID	: air navigation facility
long.	: longitude	NDB	: nondirectional beacons
LOP	: line-of-position	NFDC	: National Flight Data Center
Loran	: long range navigation	nm	: nautical mile
LOS	: line of site	NOTAM	: Notice to Airmen
LP	: linear polarization	NRKM	: nonradar keyboard multiplexer
LRCO	: limited remote communications outlet	NTSB	: National Transportation Safety Board
LSES	: loran signal evaluation system		
m	: meter	OBS	: omnibearing selector
M	: mega ($=10^6$)	OCI	: out of coverage indication
mA	: milliampere	ODALS	: omnidirectional approach lighting system
MAA	: maximum authorized altitude	OM	: outer marker
MAHP	: missed approach holding point	orb.	: orbit
MAHWP	: missed approach holding waypoint	OVLY	: GPS overlay crosstrack error
MALS	: medium intensity approach lights—5,000 cp	XTKER	

PAPI	: precision approach path indicator	RWY	: runway
P code	: precision code		
PAR	: precision approach radar		
PD	: power density	s	: second
PDOP	: precision dilution of position	S.	: South
PE	: permanent echo	SA	: selective availability
PFE	: path following error	SALS	: short approach light system
PFN	: path following noise	SAVASI	: simplified abbreviated visual approach slope indicator system
PIDP	: programmable indicator data processor	SDF	: simplified directional facility
PPI	: plan position indicator	sec	: second
PPS	: precise positioning service, P-code	SECRA	: secondary radar
PRF	: pulse-repetition frequency	SER	: stop end of runway
PRN	: pseudo-range number	SIAP	: standard instrument approach procedure
PT	: procedure turn	SID	: standard instrument departure
PVD	: plan view display	SINE	: site integration of NAS equipment
		SLS	: side lobe suppression
QARS	: quick analysis of radar sites	SNR	: Signal-to-noise ratio
		SNR-FS	: Signal-to-noise ratio-field strength
RADAR or radar	: radio range and detecting	SNR-PH	: Signal-to-noise ratio-phase
RADES	: Radar Evaluation Squadron (military)	SPAR	: system performance analysis rating
RAG	: range and azimuth gating	SPS	: standard positioning service, C/A code
RAIL	: runway alignment indicator light	SSALF	: simplified short approach light system; sequenced flashing lights
RAIM	: receiver autonomous integrity monitoring	SSALR	: same as SSALF; runway alignment indicator lights
RAPCON	: radar approach control (USAF)	SSV	: standard service volume
RAPPI	: Radar plan position indicator	STAR	: standard terminal arrival route
RARRE	: range, azimuth radar reenforced evaluator	STC	: sensitivity time control
		STOL	: short takeoff and landing
RATCC	: radar approach control center (USN)		
RBDE	: radar bright display equipment	TACAN	: tactical air navigation
RCAG	: remote, center air/ground communication facility	TAR	: test analysis report
RCO	: remote communication outlet	TCH	: threshold crossing height
RDAS	: radar data analysis software	T-Class	: terminal VOR, TACAN, or VORTAC
RDH	: runway datum height	TCOM	: terminal communications
rec	: receiver	TD	: time difference
ref	: reference	TDI	: TACAN distance indicator
REIL	: runway end identifier light	TDM	: time division multiplex
RF	: radio frequency	TDR	: touchdown reflector
RFI	: radio frequency interference	TDZ	: touchdown zone
RMI	: radio magnetic indicator	TDZL	: touchdown zone lights
RML	: radar microwave link	TERPS	: terminal instrument procedures
RNAV	: area navigation	TH	: threshold
RNP	: required navigation performance	TLS	: Transponder Landing System
ROC	: required obstruction clearance	TOWP	: take-off waypoint
RPI	: runway point of intercept	T/R	: transponder-radar (system)
RPM	: revolutions per minute	TRACALS	: traffic control and landing systems
RRP	: runway reference point	TRACON	: terminal radar approach control (FAA)
RSCAN	: radar statistical coverage analysis system	TRIAD	: 3 Loran C stations of a specific chain
		TRSB	: time reference scanning beam
RTQC	: real time quality check	T-VASI	: T (configuration)—visual approach slope indicator
R/T	: receiver-transmitter		
RTT	: radio telemetering theodolite	TVOR	: terminal VOR
RVR	: runway visual range	TWEB	: transcribed weather broadcast equipment
RVV	: runway visual value		

302.7 Glide Slope**Glidepath Width or Angles**

$$\theta = \arctan \frac{A}{D \pm F}$$

Where:

 θ = Angle (degrees)

A = Absolute (Tapeline) altitude (ft) above the glide slope antenna

D = Geodetic distance (ft) from the glide slope antenna to the outer marker (or checkpoint)

$$F = 6076.1 \left(\frac{V}{3600} \right) T$$

NOTE: F is a factor. The value and sign (plus or minus) is determined by the location of the computation point on the recording.

- Assign a minus value to F if T occurs between the outer marker (or checkpoint) and the facility
- Assign a plus value to F if T occurs prior to the outer marker (or checkpoint)

V = Ground speed (knots)

T = Time to computation point (e.g., 75uA, 150HZ, 0uA, 75uA 90Hz for path width, and angle)

302.8 Precision Approach**Glidepath Angle**

$$(1) \theta = \frac{A(0.00943)}{D}$$

Where:

 θ = Glidepath Angle (degrees)

A = Absolute (Tapeline) altitude (ft) above the glide slope antenna

D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

$$(2) \theta = \frac{A(l_1)}{106(D)(l_2)}$$

Where:

 θ = Glidepath Angle (degrees)

A = Absolute (Tapeline) altitude (ft) above the glide slope antenna

 l_1 = Inches or units of recording paper from surveyed checkpoint to RPI l_2 = Inches or units of recording paper from RPI to the point where the glidepath is crossed

D = Distance from the Runway Point of Intercept (RPI) to the point where the glidepath is crossed (nm to the nearest thousandth)

302.9 Procedures**Gradient and Climb Rates**

$$\frac{Cfd}{60} : \frac{Gr}{1} : \frac{Cr}{Gs}$$

Where:

Cfd = Climb rate (ft/nm)

Gr = Gradient (in percent/100)

Cr = Rate of Climb (ft/min)

Gs = Ground Speed (knots)

This formula is expressed as a ratio which can be solved directly on a pilot's computer (e.g., Jeppson CR-3)

302.10 MLS PFE/PFN Angular Tolerance

$$\theta = \arctan \frac{Tf}{D}$$

Where:

 θ = Angular Tolerance at measure point.

Tf = PFE/PFN Tolerance in feet

D = Distance in feet from Azimuth antenna to Tolerance reference Point (ARD or MAP).

SECTION 305. FREQUENCY SPECTRUM

305.1 Frequency Allocation.

The following is a tabulation of frequencies available for use in the aeronautical, broadcast, and mobile bands. This tabulation may be used as an aid for identifying potential sources of interference. Also included is the VHF/UHF NAVAID Frequency Channeling and Pairing Chart which covers the X and Y channels for TACAN, 50 kHz spacing for VOR and LOC, and 150 kHz GS spacing. The Frequency Management Office can provide additional information regarding users of specific frequencies or bands of frequencies.

Frequency	Service
10 - 14 kHz -----	Omega
70 - 130 kHz -----	Decca-Dectra
192 and 194 kHz -----	Consolan (Shared with point-to-point communications).
200-415 kHz-----	L/MF radio beacons, ranges, and tower voice (285-325 kHz and 405-415 kHz shared with maritime navigational aids).
1605 kHz-24 mHz-----	MF/HF Communications (shared with all services and Government/non-Government users).
90 -110 kHz -----	Loran-C
75m Hz -----	VHF Marker Beacons
108-118 mHz-----	ILS Localizer & VOR
118-136 mHz-----	VHF Communications
162-174 mHz-----	Relay/Control of VORTAC
225-328.6 mHz -----	UHFCommunications
328.6-335.4 mHz-----	ILS Glide Slope
335.4-400 mHz -----	UHF Communications
406-420 mHz-----	Relay/Control of VORTAC
420-460 mHz-----	Radio Altimeter
960-1215 mHz-----	TACAN and DME
1030 mHz and 1090 mHz----	ATC Radar Beacon
1215-1400 mHz -----	Long Range Surveillance Radar
1435-1535 mHz -----	Aeronautical Telemetry (Flight Tests)
1535-1542.5 mHz-----	Maritime Mobile-Satellite
1542.5-1543.5 mHz -----	Aeronautical Mobile-Satellite (R) and Maritime Mobile-Satellite

Frequency	Service
1543.5-1558.5 mHz-----	Aeronautical Mobile-Satellite (R)
1558.5-1636.5 mHz-----	Aeronautical Radio Navigation
1636.5-1644 mHz -----	Maritime Mobile-Satellite
1644-1645 mHz-----	Aeronautical Mobile-Satellite (R) and Maritime Mobile Satellite
1645-1660 mHz-----	Aeronautical Mobile Satellite (R)
2700-2900 mHz-----	Airport Surveillance Radar (shared with meteorological radar).
4200-4400 mHz-----	Radar Altimeter
5000-5250 mHz-----	Reserved for Aeronautical Radio Navigation and Space Radio Communication
5350-5470 mHz-----	Airborne Weather Radar
7125-8400 mHz-----	Microwave Link for Long Range Radar Relay
8800 mHz -----	Airborne Doppler Radar
9000-9200 mHz-----	Precision Approach Radar (PAR)
9300-9500 mHz-----	Airborne Weather Radar
13.25-13.4 GHz -----	Doppler Navigaton Aids
15.4-15.7 GHz -----	Reserved for Aeronautical Radio Navigation and Space Radio Communications
24.25-24.47 GHz-----	Airport Surface Detech Radar (ASDE)

Frequency	Broadcast
540-1600 kHz -----	Standard USA
2300-2495 kHz-----	Tropical Zone only
2500 kHz -----	WWV Standard Frequency
3200-3400 kHz-----	Tropical Zone only
3900-4000 kHz-----	International (Region 3 only)
3950-4000 kHz-----	International (Region 1 only)
4750-4995 kHz-----	Tropical Zone only
5000 kHz -----	WWV Standard Frequency
5005-5060 kHz-----	Tropical Zone only
5950-6200 kHz-----	International
9500-9775 kHz-----	International
10 mHz -----	WWV Standard Frequency
11.7-11.975 mHz-----	International
15 mHz -----	WWV Standard Frequency
15.1-15.45 mHz-----	International
17.7-17.9 mHz-----	International
20 mHz -----	WWV Standard Frequency
21.45-21.75 mHz-----	International
25 mHz -----	WWV Standard Frequency
25.6-26.1 mHz -----	International
54-72 mHz -----	Television, VHF
76-88 mHz -----	Television, VHF
88-108 mHz -----	FM
174-216 mHz-----	Television, VHF
470-890 mHz-----	Television, UHF

305.2 NOMENCLATURE OF FREQUENCY BANDS

305.21 International

VLF—Very Low Frequency—0-30 kHz

LF —Low Frequency—30-300 kHz

MF —Medium Frequency—300-3,000 kHz

HF —High Frequency—3,000-30,000 kHz

VHF—Very High Frequency—30,000 kHz-300 MHz

UHF—Ultra High Frequency—300-3,000 MHz

SHF—Super High Frequency—3,000-30,000 MHz

EHF—Extremely High Frequency—30,000-300,000 MHz

305.22 VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING

							DME AIRBORNE INTERROGATE			DME GND REPLY	
DME CHN NO.	-----FREQUENCY-----				MLS CHN NO.	FREQ	PULSE CODE			DME FREQ	PC us
	LOC	GS	VOR	MLS			NORMAL	P/DME			
							DME us	IA us	FA us		
1X	-	-	-	-	-	1025	12	--	--	962	12
1Y	-	-	-	-	-	1025	36	--	--	1088	30
2X	-	-	-	-	-	1026	12	--	--	963	12
2Y	-	-	-	-	-	1026	36	--	--	1089	30
3X	-	-	-	-	-	1027	12	--	--	964	12
3Y	-	-	-	-	-	1027	36	--	--	1090	30
4X	-	-	-	-	-	1028	12	--	--	965	12
4Y	-	-	-	-	-	1028	36	--	--	1091	30
5X	-	-	-	-	-	1029	12	--	--	966	12
5Y	-	-	-	-	-	1029	36	-	-	1092	30
6X	-	-	-	-	-	1030	12	-	-	967	12
6Y	-	-	-	-	-	1030	36	-	-	1093	30
7X	-	-	-	-	-	1031	12	-	-	968	12
7Y	-	-	-	-	-	1031	36	-	-	1094	30
8X	-	-	-	-	-	1032	12	-	-	969	12
8Y	-	-	-	-	-	1032	36	-	-	1095	30
9X	-	-	-	-	-	1033	12	-	-	970	12
9Y	-	-	-	-	-	1033	36	-	-	1096	30
10X	-	-	-	-	-	1034	12	-	-	971	12
10Y	-	-	-	-	-	1034	36	-	-	1097	30
11X	-	-	-	-	-	1035	12	-	-	972	12
11Y	-	-	-	-	-	1035	36	-	-	1098	30
12X	-	-	-	-	-	1036	12	-	-	973	12
12Y	-	-	-	-	-	1036	36	-	-	1099	30
13X	-	-	-	-	-	1037	12	-	-	974	12
13Y	-	-	-	-	-	1037	36	-	-	1100	30
14X	-	-	-	-	-	1038	12	-	-	975	12
14Y	-	-	-	-	-	1038	36	-	-	1101	30
15X	-	-	-	-	-	1039	12	-	-	976	12
15Y	-	-	-	-	-	1039	36	-	-	1102	30
16X	-	-	-	-	-	1040	12	-	-	977	12
16Y	-	-	-	-	-	1040	36	-	-	1103	30
17X	-	-	108.00	-	-	1041	12	-	-	978	12
17Y	-	-	108.05	5043.0	540	1041	36	36	42	1104	30
18X	108.10	334.70	-	5031.0	500	1042	12	12	18	979	12
18Y	108.15	334.55	-	5043.6	542	1042	36	36	42	1105	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	-----FREQUENCY----- LOC GS VOR MLS				MLS CHN NO.	FREQ	DME AIRBORNE INTERROGATE			DME GND REPLY	
							PULSE CODE			DME FREQ	PC us
							NORMAL DME us	IA us	FA us		
19X	-	-	108.20	-	-	1043	12	-	-	980	12
19Y	-	-	108.25	-	-	1043	36	36	42	1106	30
20X	108.30	334.10	-	5031.6	502	1044	12	12	18	981	12
20Y	108.35	333.95	-	5044.8	546	1044	36	36	42	1107	30
21X	-	-	108.40	-	-	1045	12	-	-	982	12
21Y	-	-	108.45	5045.4	548	1045	36	36	42	1108	30
22X	108.50	329.90	-	5032.2	504	1046	12	12	18	983	12
22Y	108.55	329.75	-	5046.0	550	1046	36	36	42	1109	30
23X	-	-	108.60	-	-	1047	12	-	-	984	12
23Y	-	-	108.65	5046.6	552	1047	36	36	42	1110	30
24X	108.70	330.50	-	5032.8	506	1048	12	12	18	985	12
24Y	108.75	330.35	-	5047.2	554	1048	36	36	42	1111	30
25X	-	-	108.80	-	-	1049	12	-	-	986	12
25Y	-	-	108.85	5047.8	556	1049	36	36	42	1112	30
26X	108.90	329.30	-	5033.4	508	1050	12	12	18	987	12
26Y	108.95	329.15	-	5048.4	558	1050	36	36	42	1113	30
27X	-	-	109.00	-	-	1051	12	-	-	988	12
27Y	-	-	109.05	5049.0	560	1051	36	36	42	1114	30
28X	109.10	331.40	-	5034.0	510	1052	12	12	18	989	12
28Y	109.15	331.25	-	5049.6	562	1052	36	36	42	1115	30
29X	-	-	109.20	-	-	1053	12	-	-	990	12
29Y	-	-	109.25	5050.2	564	1053	36	36	42	1116	30
30X	109.30	332.00	-	5034.6	512	1054	12	12	18	991	12
30Y	109.35	331.85	-	5050.8	556	1054	36	36	42	1117	30
31X	-	-	109.40	-	-	1055	12	-	-	992	12
31Y	-	-	109.45	5051.4	568	1055	36	36	42	1118	30
32X	109.50	332.60	-	5035.2	514	1056	12	12	18	993	12
32Y	109.55	332.45	-	5052.0	570	1056	36	36	42	1119	30
33X	-	-	109.60	-	-	1057	12	-	-	994	12
33Y	-	-	109.65	5052.6	572	1057	36	36	42	1120	30
34X	109.70	333.20	-	5035.8	516	1058	12	12	18	995	12
34Y	109.75	333.05	-	5035.2	574	1058	36	36	42	1121	30
35X	-	-	109.80	-	-	1059	12	-	-	996	12
35Y	-	-	109.85	5053.8	576	1059	36	36	42	1122	30
36X	109.90	333.80	-	5036.4	518	1060	12	12	18	997	12
36Y	109.95	333.65	-	5054.4	578	1060	36	36	42	1123	30
37X	-	-	110.00	-	-	1061	12	-	-	998	12
37Y	-	-	110.05	5055.0	580	1061	36	36	42	1124	30
38X	110.10	334.40	-	5037.0	520	1062	12	12	18	999	12
39X	-	-	110.20	-	-	1063	12	-	-	1000	12
39Y	-	-	110.25	5056.2	584	1063	36	36	42	1126	30
40X	110.30	335.00	-	5037.6	522	1064	12	12	18	1001	12
40Y	110.35	334.85	-	5056.8	586	1064	36	36	42	1127	30
41X	-	-	110.40	-	-	1065	12	-	-	1002	12
41Y	-	-	110.45	5057.4	588	1065	36	36	42	1128	30
42X	110.50	329.60	-	5038.2	524	1066	12	12	18	1003	12
42Y	110.55	329.45	-	5058.0	590	1066	36	36	42	1129	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.	-----FREQUENCY----- LOC GS VOR MLS				MLS CHN NO.	FREQ	DME AIRBORNE INTERROGATE			DME GND REPLY	
							PULSE CODE			DME FREQ	PC us
							NORMAL	P/DME			
							DME us	IA us	FA us		
43X	-	-	110.60	-	-	1067	12	-	-	1004	12
43Y	-	-	110.65	5058.6	592	1067	36	36	42	1130	30
44X	110.70	330.20	-	5038.8	526	1068	12	12	18	1005	12
44Y	110.75	330.05	-	5059.2	594	1068	36	36	42	1131	30
45X	-	-	110.80	-	-	1069	12	-	-	1006	12
45Y	-	-	110.85	5059.8	596	1069	36	36	42	1132	30
46X	110.90	330.80	-	5039.4	528	1070	12	12	18	1007	12
46Y	110.95	330.65	-	5060.4	598	1070	36	36	42	1133	30
47X	-	-	111.00	-	-	1071	12	-	-	1008	12
47Y	-	-	111.05	5061.0	600	1071	36	36	42	1134	30
48X	111.10	331.70	-	5040.0	530	1072	12	12	18	1009	12
48Y	111.15	331.55	-	5061.6	602	1072	36	36	42	1135	30
49X	-	-	111.20	-	-	1073	12	-	-	1010	12
49Y	-	-	111.25	6062.2	604	1073	36	36	42	1136	30
50X	111.30	332.30	-	5040.6	532	1074	12	12	18	1011	12
50Y	111.35	332.15	-	5062.8	606	1074	36	36	42	1137	30
51X	-	-	111.40	-	-	1075	12	-	-	1012	12
51Y	-	-	111.45	5063.4	608	1075	36	36	42	1136	30
52X	111.50	332.90	-	5041.2	534	1076	12	12	18	1013	12
52Y	111.55	332.75	-	5064.0	610	1076	36	36	42	1139	30
53X	-	-	111.60	-	-	1077	12	-	-	1014	12
53Y	-	-	111.65	5064.4	612	1077	36	36	42	1140	30
54X	111.70	333.50	-	5041.8	536	1078	12	12	18	1015	12
54Y	111.75	333.35	-	5065.2	614	1078	36	36	42	1141	30
55X	-	-	111.80	-	-	1079	12	-	-	1016	12
55Y	-	-	111.85	5065.8	616	1079	36	36	42	1142	30
56X	111.90	331.10	-	5042.4	538	1080	12	12	18	1017	12
56Y	111.95	330.95	-	5066.4	618	1080	36	36	42	1143	30
57X	-	-	112.00	-	-	1081	12	-	-	1018	12
57Y	-	-	112.05	-	-	1081	36	-	-	1144	30
58X	-	-	112.10	-	-	1082	12	-	-	1019	12
58Y	-	-	112.15	-	-	1082	36	-	-	1145	30
59X	-	-	112.20	-	-	1083	12	-	-	1020	12
59Y	-	-	112.25	-	-	1083	36	-	-	1146	30
60X	-	-	-	-	-	1084	12	-	-	1021	12
60Y	-	-	-	-	-	1084	36	-	-	1147	30
61X	-	-	-	-	-	1085	12	-	-	1022	12
61Y	-	-	-	-	-	1085	36	-	-	1148	30
62X	-	-	-	-	-	1086	12	-	-	1023	12
62Y	-	-	-	-	-	1086	36	-	-	1149	30
63X	-	-	-	-	-	1087	12	-	-	1024	12
63Y	-	-	-	-	-	1087	36	-	-	1150	30
64X	-	-	-	-	-	1088	12	-	-	1151	12
64Y	-	-	-	-	-	1088	36	-	-	1025	30
65X	-	-	-	-	-	1089	12	-	-	1152	12
65Y	-	-	-	-	-	1089	36	-	-	1026	30
66X	-	-	-	-	-	1090	12	-	-	1153	12
66Y	-	-	-	-	-	1090	36	-	-	1027	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

							DME AIRBORNE INTERROGATE			DME GND REPLY	
DME CHN NO.	-----FREQUENCY-----				MLS CHN NO.	FREQ	PULSE CODE			DME FREQ	PC us
	LOC	GS	VOR	MLS			NORMAL	P/DME			
							DME us	IA us	FA us		
67X	-	-	-	-	-	1091	12	-	-	1154	12
67Y	-	-	-	-	-	1091	36	-	-	1028	30
68X	-	-	-	-	-	1092	12	-	-	1155	12
68Y	-	-	-	-	-	1092	36	-	-	1029	30
69X	-	-	-	-	-	1093	12	-	-	1156	12
69Y	-	-	-	-	-	1093	36	-	-	1030	30
70X	-	-	112.30	-	-	1094	12	-	-	1157	12
70Y	-	-	112.35	-	-	1094	36	-	-	1031	30
71X	-	-	112.40	-	-	1095	12	-	-	1158	12
71Y	-	-	112.45	-	-	1095	36	-	-	1032	30
72X	-	-	112.50	-	-	1096	12	-	-	1159	12
72Y	-	-	112.55	-	-	1096	36	-	-	1033	30
73X	-	-	112.60	-	-	1097	12	-	-	1160	12
73Y	-	-	112.65	-	-	1097	36	-	-	1034	30
74X	-	-	112.70	-	-	1098	12	-	-	1161	12
74Y	-	-	112.75	-	-	1098	36	-	-	1035	30
75X	-	-	112.80	-	-	1099	12	-	-	1162	12
75Y	-	-	112.85	-	-	1099	36	-	-	1036	30
76X	-	-	112.90	-	-	1100	12	-	-	1163	12
76Y	-	-	112.95	-	-	1100	36	-	-	1037	30
77X	-	-	113.00	-	-	1101	12	-	-	1164	12
77Y	-	-	113.05	-	-	1101	36	-	-	1038	30
78X	-	-	113.10	-	-	1102	12	-	-	1165	12
78Y	-	-	113.15	-	-	1102	36	-	-	1039	30
79X	-	-	113.20	-	-	1103	12	-	-	1166	12
79Y	-	-	113.25	-	-	1103	36	-	-	1040	30
80X	-	-	113.30	-	-	1104	12	-	-	1167	12
80Y	-	-	113.35	5067.0	620	1104	36	36	42	1041	30
81X	-	-	113.40	-	-	1105	12	-	-	1168	12
81Y	-	-	113.45	5067.6	622	1105	36	36	42	1042	30
82X	-	-	113.50	-	-	1106	12	-	-	1169	12
82Y	-	-	113.55	5068.2	624	1106	36	36	42	1043	30
83X	-	-	113.60	-	-	1107	12	-	-	1170	12
83Y	-	-	113.65	5068.8	626	1107	36	36	42	1044	30
84X	-	-	113.70	-	-	1108	12	-	-	1171	12
84Y	-	-	113.75	5069.4	628	1108	36	36	42	1045	30
85X	-	-	113.80	-	-	1109	12	-	-	1172	12
85Y	-	-	113.85	5070.0	630	1109	36	36	42	1046	30
86X	-	-	113.90	-	-	1110	12	-	-	1173	12
86Y	-	-	113.95	5070.6	632	1110	36	36	42	1047	30
87X	-	-	114.00	-	-	1111	12	-	-	1174	12
87Y	-	-	114.05	5071.2	634	1111	36	36	42	1048	30
88X	-	-	114.10	-	-	1112	12	-	-	1175	12
88Y	-	-	114.15	5071.8	636	1112	36	36	42	1049	30
89X	-	-	114.20	-	-	1113	12	-	-	1176	12
89Y	-	-	114.25	5072.4	638	1113	36	36	42	1050	30
90X	-	-	114.30	-	-	1114	12	-	-	1177	12
90Y	-	-	114.35	5073.0	640	1114	36	36	42	1051	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

DME CHN NO.							DME AIRBORNE INTERROGATE			DME GND REPLY	
	-----FREQUENCY-----				MLS CHN NO.	FREQ	PULSE CODE			DME FREQ	PC us
	LOC	GS	VOR	MLS			NORMAL DME us	P/DME			
								IA us	FA us		
91X	-	-	114.40	-	-	1115	12	-	-	1178	12
91Y	-	-	114.45	5073.6	642	1115	36	36	42	1052	30
92X	-	-	114.50	-	-	1116	12	-	-	1179	12
92Y	-	-	114.55	5074.2	644	1116	36	36	42	1053	30
93X	-	-	114.60	-	-	1117	12	-	-	1180	12
93Y	-	-	114.65	5074.8	646	1117	36	36	42	1054	30
94X	-	-	114.70	-	-	1118	12	-	-	1181	12
94Y	-	-	114.75	5075.4	648	1118	36	36	42	1055	30
95X	-	-	114.80	-	-	1119	12	-	-	1182	12
95Y	-	-	114.85	5076.0	650	1119	36	36	42	1056	30
96X	-	-	114.90	-	-	1120	12	-	-	1183	12
96Y	-	-	114.95	5076.6	652	1120	36	36	42	1057	30
97X	-	-	115.00	-	-	1121	12	-	-	1184	12
97Y	-	-	115.05	5077.2	654	1121	36	36	42	1058	30
98X	-	-	115.10	-	-	1122	12	-	-	1185	12
98Y	-	-	115.15	5077.8	656	1122	36	36	42	1059	30
99X	-	-	115.20	-	-	1123	12	-	-	1186	12
99Y	-	-	115.25	5078.4	658	1123	36	36	42	1060	30
100X	-	-	115.30	-	-	1124	12	-	-	1187	12
100Y	-	-	115.35	5079.0	660	1124	36	36	42	1061	30
101X	-	-	115.40	-	-	1125	12	-	-	1188	12
101Y	-	-	115.45	5079.6	662	1125	36	36	42	1062	30
102X	-	-	115.50	-	-	1126	12	-	-	1189	12
102Y	-	-	115.55	5080.2	664	1126	36	36	42	1063	30
103X	-	-	115.60	-	-	1127	12	-	-	1190	12
103Y	-	-	115.65	5080.8	666	1127	36	36	42	1064	30
104X	-	-	115.70	-	-	1128	12	-	-	1191	12
104Y	-	-	115.75	5081.4	668	1128	36	36	42	1065	30
105X	-	-	115.80	-	-	1129	12	-	-	1192	12
105Y	-	-	115.85	5082.0	670	1129	36	36	42	1066	30
106X	-	-	115.90	-	-	1130	12	-	-	1193	12
106Y	-	-	115.95	5082.6	672	1130	36	36	42	1067	30
107X	-	-	116.00	-	-	1131	12	-	-	1194	12
107Y	-	-	116.05	5083.2	674	1131	36	36	42	1068	30
108X	-	-	116.10	-	-	1132	12	-	-	1195	12
108Y	-	-	116.15	5083.8	676	1132	36	36	42	1069	30
109X	-	-	116.20	-	-	1133	12	-	-	1196	12
109Y	-	-	116.25	5084.4	678	1133	36	36	42	1070	30
110X	-	-	116.30	-	-	1134	12	-	-	1197	12
110Y	-	-	116.35	5085.0	680	1134	36	36	42	1071	30
111X	-	-	116.40	-	-	1135	12	-	-	1198	12
111Y	-	-	116.45	5085.6	682	1135	36	36	42	1072	30
112X	-	-	116.50	-	-	1136	12	-	-	1199	12
112Y	-	-	116.55	5086.2	684	1136	36	36	42	1073	30
113X	-	-	116.60	-	-	1137	12	-	-	1200	12
113Y	-	-	116.65	5086.8	686	1137	36	36	42	1074	30
114X	-	-	116.70	-	-	1138	12	-	-	1201	12
114Y	-	-	116.75	5087.4	688	1138	36	36	42	1075	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

							DME AIRBORNE INTERROGATE			DME GND REPLY	
DME CHN NO.	-----FREQUENCY-----				MLS CHN NO.	FREQ	PULSE CODE			DME FREQ	PC us
	LOC	GS	VOR	MLS			NORMAL	P/DME			
							DME us	IA us	FA us		
115X	-	-	116.80	-	-	1139	12	-	-	1202	12
115Y	-	-	116.85	5088.0	690	1139	36	36	42	1076	30
116X	-	-	116.90	-	-	1140	12	-	-	1203	12
116Y	-	-	116.95	5088.6	692	1140	36	36	42	1077	30
117X	-	-	117.00	-	-	1141	12	-	-	1204	12
117Y	-	-	117.05	5089.2	694	1141	36	36	42	1078	30
118X	-	-	117.10	-	-	1142	12	-	-	1205	12
118Y	-	-	117.15	5089.8	696	1142	36	36	42	1079	30
119X	-	-	117.20	-	-	1143	12	-	-	1206	12
119Y	-	-	117.25	5090.4	698	1143	36	36	42	1080	30
120X	-	-	117.30	-	-	1144	12	-	-	1207	12
120Y	-	-	117.35	-	-	1144	36	-	-	1081	30
121X	-	-	117.40	-	-	1145	12	-	-	1208	12
121Y	-	-	117.45	-	-	1145	36	-	-	1082	30
122X	-	-	117.50	-	-	1146	12	-	-	1209	12
122Y	-	-	117.55	-	-	1146	36	-	-	1083	30
123X	-	-	117.60	-	-	1147	12	-	-	1210	12
123Y	-	-	117.65	-	-	1147	36	-	-	1084	30
124X	-	-	117.70	-	-	1148	12	-	-	1211	12
124Y	-	-	117.75	-	-	1148	36	-	-	1085	30
125X	-	-	117.80	-	-	1149	12	-	-	1212	12
125Y	-	-	117.85	-	-	1149	36	-	-	1086	30
126X	-	-	117.90	-	-	1150	12	-	-	1213	12
126Y	-	-	117.95	-	-	1150	36	-	-	1087	30

VHF/UHF NAVAID FREQUENCY CHANNELING AND PAIRING, CONTINUED

							DME AIRBORNE INTERROGATE			DME GND REPLY	
DME CHN NO.	-----FREQUENCY-----				MLS CHN NO.	FREQ	PULSE CODE			DME FREQ	PC us
	LOC	GS	VOR	MLS			NORMAL	P/DME			
							DME us	IA us	FA us		
115X	-	-	116.80	-	-	1139	12	-	-	1202	12
115Y	-	-	116.85	5088.0	690	1139	36	36	42	1076	30
116X	-	-	116.90	-	-	1140	12	-	-	1203	12
116Y	-	-	116.95	5088.6	692	1140	36	36	42	1077	30
117X	-	-	117.00	-	-	1141	12	-	-	1204	12
117Y	-	-	117.05	5089.2	694	1141	36	36	42	1078	30
118X	-	-	117.10	-	-	1142	12	-	-	1205	12
118Y	-	-	117.15	5089.8	696	1142	36	36	42	1079	30
119X	-	-	117.20	-	-	1143	12	-	-	1206	12
119Y	-	-	117.25	5090.4	698	1143	36	36	42	1080	30
120X	-	-	117.30	-	-	1144	12	-	-	1207	12
120Y	-	-	117.35	-	-	1144	36	-	-	1081	30
121X	-	-	117.40	-	-	1145	12	-	-	1208	12
121Y	-	-	117.45	-	-	1145	36	-	-	1082	30
122X	-	-	117.50	-	-	1146	12	-	-	1209	12
122Y	-	-	117.55	-	-	1146	36	-	-	1083	30
123X	-	-	117.60	-	-	1147	12	-	-	1210	12
123Y	-	-	117.65	-	-	1147	36	-	-	1084	30
124X	-	-	117.70	-	-	1148	12	-	-	1211	12
124Y	-	-	117.75	-	-	1148	36	-	-	1085	30
125X	-	-	117.80	-	-	1149	12	-	-	1212	12
125Y	-	-	117.85	-	-	1149	36	-	-	1086	30
126X	-	-	117.90	-	-	1150	12	-	-	1213	12
126Y	-	-	117.95	-	-	1150	36	-	-	1087	30